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Design and Fabrication of Economic Motorized Wheelchair

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ABSTRACT:

Wheelchair is the device which is mainly used for physically challenged people. In the earlier day's wheelchair were existed manually and dependent on other person for the mobility. In case a patient who has challenge in using their hands for mobility, then he/she needs another person help for mobility. In the world of Engineering, the Engineers play a vital role in the development of the society and provide comfort in their lifestyle. With this as primary objective our project had evolved the wheelchair with automatic control.

***Keywords: 24v DC Motor, 12v Battery, Pushback seat, Lever and Steering mechanism*.**

1. INTRODUCTION:

In modern days the motorized wheelchair the mobility is controlled by joystick, and development of wheelchair are higher in cost. In order to reduce the cost, make it affordable and help the patient not to be dependent on another person in their commuting we had designed this motorized wheelchair. As we had discussed earlier about both the Motorized and manually operated wheelchair, now we a quite very much know about its function and estimation of it. Hence the little bit changes have made in the evolution of the wheelchair which already exist. Therefore by considering that the manually operated wheel chair finds difficult in self-propelling by a patient and also he is always in the dependency of some other person. That he can't do anything without seeking help from another person.

2. LITERATURE REVIEW:

The article by the Snehlata Yadav, Poonam Sheoran [1] presents a summary of current state of smart wheelchairs. An assistive technology known as wheelchair is used to deal with the loss of mobility for the patients who are not able to walk and find difficulty in walking due to some injury or age factor related walking disabilities (permanent or under treatment). Out of all the methodologies, (HCI) Human Computer Interface and (HMI) Human Machine Interface are the latest and most effective techniques. In the article Gurjot Singh Gaba, Paramdeep Sing and Sandeep Kumar Arora [2] It explains that which the possible other organs of the body assist with the electronic gadgets. Proposed method can helps out the physically challenged person to make their journey through electronic assisted module which works on the signal processing over speech and image. This system works via speech or through recognition of hand gesture. In the article Sheldon and Jacobs [3] it represent the Manual form of wheelchairs designed in the traditional way offer mobility for those individual persons who possessing both cognitive and physical impairments. The demand of manual wheelchair is compared to the wheelchairs driven by power as both physical as well as cognitive skills are necessary for powered wheelchairs that might not needed among all individuals. Tadakamalla Shanmukh Anirudh, Jyoti Pragyan Satpathy [4] it describe electric-powered wheelchair or motorized wheelchair is a wheelchair that which propelled by means of a motor rather than manual power. Motorized wheelchairs are been used for those who cannot not able to impel a manual wheelchair or who may need to employ a wheelchair for a distances or over terrain which would be strenuous in the manual wheelchair.

3. THE MAIN PROBLEM OF USING THE EXISTING WHEEL CHAIR:

- In the manually operated wheelchair a need of the external or the aid of another person is essential.
- In the automated wheel chair the usage of joystick makes the component very costly
- For the poor people they find more difficult to buy of use of the automated wheelchair.
- In manual there must be always a person to help him whenever he wants to move over.

4. BASIC COMPONENTS USED:

- **STEEL FRAME**

- **WHEELS**
- **24v DC MOTOR**
- **BEVEL GEAR**
- **SWITCHES**
- **PUSHBACK SEAT**
- **LEVER**
- **12v BATTERY**

A. FRAME DESIGN 3D DRAWING:

3D drawing for the project is given below in figure; here for the front wheel the wheel diameter is lesser than that of back wheel

Figure 1. 3D drawing

By considering the wheelchair of economic value the hollow tubular frame is selected which is higher strength and the area is higher than the rectangular section and I-section.

B. CALCULATION OF FRAME:

For circular shaft,

$$\sigma_b = \frac{32M_b}{\pi d^3}$$ Where,

M_b - Bending moment = P x l …… N mm

σ_b - Working stress ….. . N/mm^2

d - Diameter of shaft …… mmArea of the shaft, A = $\frac{\pi}{4}d^2$

…... mm^2 Therefore, Area of shaft >>> area of rectangular cross section (or) Area of I-section. Hence by considering the area and the strength of the frame the circular hollow shaft is select.

Figure 2. welding process

C. MECHANISM CONTROLLER:

STEERING MECHANISM

The primary purpose of the steering mechanism to allow the driver to guide the vehicle at right direction to reach out destination which allows any vehicle alike car, motorcycle, by means of of components, linkages, etc.

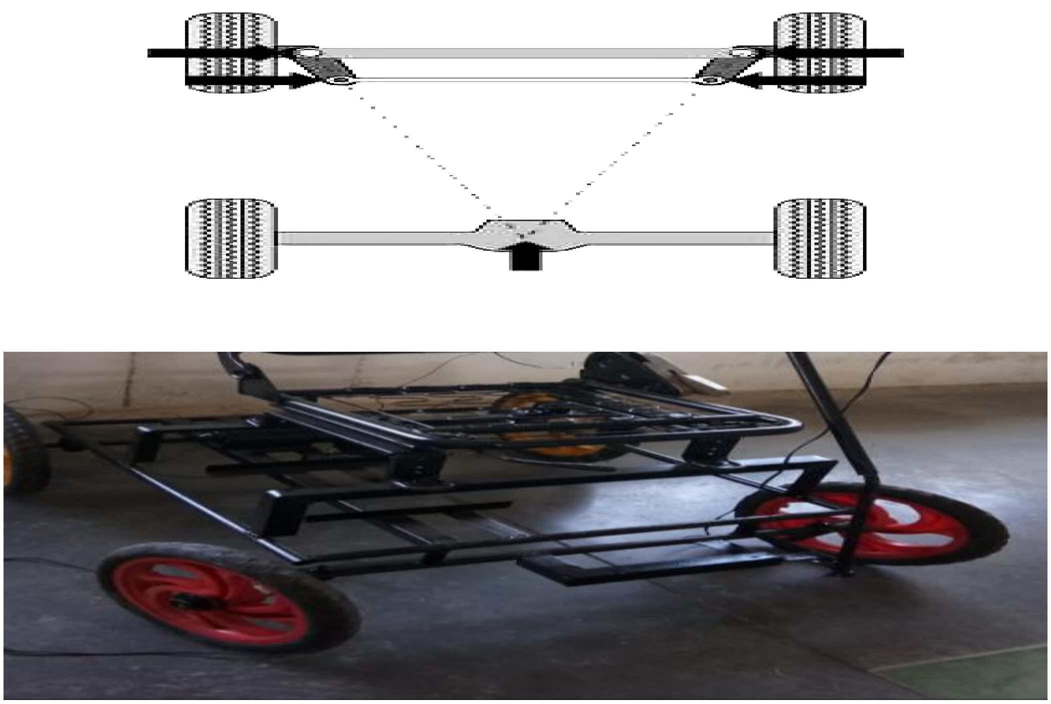

Figure 3. Steering mechanism

D. **LEVER MECHANISM:**

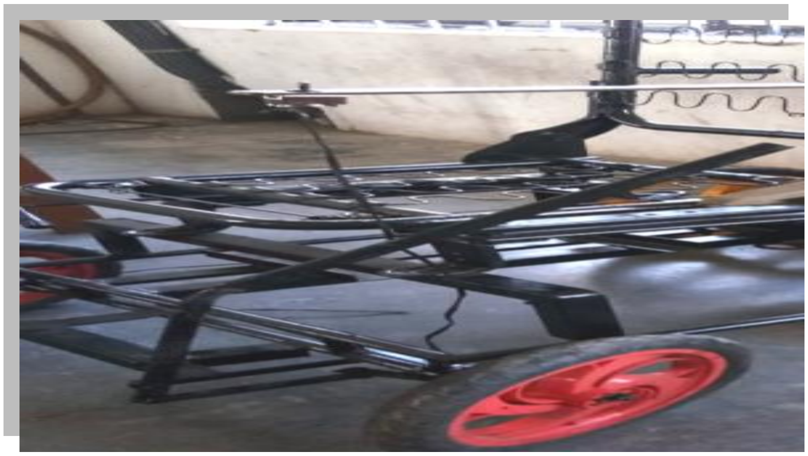

Figure 4. Lever mechanism

E. SEATING PUSHBACK MECHANISM:

Figure 5. Push back Seat

F. BEVEL GEAR:

Figure 6. Power Transmission using Bevel Gear

G. CALCULATION:

Diameter of the wheel (18") = 45.7cm = 457mm

Speed of the wheel = 20 rpm

Velocity $= \frac{\pi DN}{60000} = \frac{\pi \times 457 \times 20}{60000}$

$= 0.47 \approx 0.50$ m/s

Power (P) = F x V x1.25

Weight= 100kg

F = 100 x10 =1000N

P =1000 x 0.5 x 1.25

= 625 = 0.625 kW

≈ 0.75 Kw

BEVEL GEAR CALCULATION:

Number of teeth on the pinion $Z_1 = 10$

Number of teeth on the gear $Z_2 = 16$

Diameter of the pinion $d_1 = 40$mm

Diameter of the gear $d_2 = 60$mm

Calculation of transmission ratio (I)

$$i = \frac{Z_2}{Z_1} = \frac{16}{10} = 1.6$$

Assume speed of gear $N_1 = 100$ rpm

Speed of pinion $N_2 = \frac{i}{N_1} = \frac{100}{1.6}$

$N_2 = 62.5$ rpm

Calculation of module (m)

We know that $d = m_t \times Z$

$d_1 = m_t \times Z_1$

$40 = m_t \times 10$

$m_t = 4$

Standard module $\mathbf{m_t=5}$

Calculation of power

Diameter of the wheel (18") = 45.7cm =457mm

Speed of the wheel = 20 rpm

Velocity $= \frac{\pi DN}{60 \times 1000} = \frac{\pi \times 457 \times 20}{60000}$

$= 0.47 \approx 0.50$ m/s

Power (P) = F x V x1.25

Weight = 100kg

F = 100 x10 =1000N

P =1000 x 0.5 x 1.25

= 625 = 0.625 kW **≈ 0.75 kW**

Calculation of tangential load

$$\mathbf{F_t} = \frac{HP \times 75}{v_m}$$

$$v_m = \frac{\pi d N_1}{60 \times 1000} = \frac{\pi \times 40 \times 100}{60 \times 1000} = 0.2615\text{m/s}$$

$$F_t = \frac{0.75 \times 1.340 \times 75}{0.2615}$$

$\mathbf{F_t}$ **= 287.8 kgf**

Calculation of dynamic load

$\mathbf{F_d = F_t \times C_v \times N_{sf} \times k_s}$

$$C_v = \frac{3.5 + \sqrt{v_m}}{5.5} \text{ (assuming } V_m = 3.5\text{m/s)}$$

$$C_v = \frac{3.5 + \sqrt{3.5}}{5.5} = 0.97$$

$F_d = 287.8 \times 0.97 \times 1 \times 1$

$\mathbf{F_d = 279.14kgf}$

Calculation of beam strength

$$F_s = [\sigma_b] \times b \times y_v \times m_t \times \left(1 - \frac{b}{R}\right)$$

For alloy steel (15 Ni2 Cr1 Mo15)

$[\sigma_b] = 3200\ kg/cm^2 = 32\ kg/mm^2$

$b = 10m_t = 10 \times 5 = 50mm$

$$y_v = 0.154 - \frac{0.912}{Z_{V1}}$$

$$Z_{v1} = \frac{Z_1}{\cos\delta_1}$$

$\delta_2 = \tan^{-1}(i) = \tan^{-1}(1.6) = 57.99$

$\delta_1 = 90 - \delta_2 = 32$

$Z_{v1} = 10 \times \cos 32 = 11.79 \approx 12$ teeth

$$y_v = 0.154 - \frac{0.912}{12} = 0.078$$

$$\frac{b}{R} = 0.3$$

$F_s = 32 \times 50 \times 0.078 \times 5 \times (1 - 0.3)$

$\mathbf{F_s = 436.8\ kgf}$

Check for beam strength F_s

Fs >Fd

436.8 > 281.4kgf, therefore design is safe

Calculation of Wear Strength F_w

$$F_w = d_1 \times Q \times k \times b$$

$$Q = \frac{2 \times i}{i+1} = \frac{2 \times 1}{1+1} = 1$$

$$k = \frac{\sigma_c^{\ 2} \times \sin\alpha \times \left[\frac{1}{E_1} + \frac{1}{E_2}\right]}{1.4}$$

$$[\sigma_c] = 950 N/mm^2$$

$$E_2 = E_1 = 2.15 \times 10^5 \text{ N/mm}^2$$

$$k = \frac{950^2 \times \sin 20 \times \left[\frac{1}{2.15 \times 10^5} + \frac{1}{2.15 \times 10^5}\right]}{1.4}$$

$$k = 2.05 \text{ N/mm}^2$$

$$F_w = 40 \times 1 \times 2.05 \times 50 = 4100 \text{ N}$$

$$\mathbf{F_w = 417.9 \text{ kgf}}$$

Calculation of dynamic load

$$F_d = F_t + \frac{0.164 \times V_m (cb + F_t)}{0.164 \times V_m + 1.485\sqrt{cb + F_t}}$$

c =11860 e   [e = 0.025, for m =5 mm]

c = 296.5

$cb+F_t$ = 296.5 × 50 + 287.5 =15112.5

$$V_m = \frac{\pi \times d_1 \times N_1}{1000} = \frac{\pi \times 40 \times 100}{1000}$$

= 12.5m/min

$$F_d = 287.5 + \frac{0.164 \times 12.5(15112.5)}{0.164 \times 12.5 + 1.485\sqrt{15112.5}}$$

$$\mathbf{F_d = 358.02kgf}$$

Check for wear load

Fw > Fd **410.6 > 358.02 kgf,** therefore design is safe

Calculation of basic dimensions

(a)	**Module**	$\mathbf{m_t}$	**= 5mm**
(b)	**Cone distance**	R	$= 0.5\times m_t \sqrt{Z_1^2 + Z_2^2} = 0.5\times 5\times \sqrt{10^2 + 16^2}$
		R	**= 47.73mm**
(c)	**Pressure angle**	α	**= 20°**
(d)	**Tip diameter**	d_{a1}	$= m_t(Z_1+2\cos\delta_1) = 5(10+2\cos 32)$
		$\mathbf{d_{a1}}$	**= 58.78mm**
		d_{a2}	$= m_t(Z_2+2\cos\delta_2) = 5(16+2\cos 57.99)$
		$\mathbf{d_{a2}}$	**= 85.24mm**
(e)	**Height factor**	$\mathbf{f_0}$	**=1**
(f)	**Clearance**	**c**	**= 0.2mm**

H. EXPERIMENTALSETUP:

Figure 7. Experimental setup

WORKING PRICINPLE:

In case of Motorized wheelchair the person always in the aid of the wheelchair he spends most of his time in the wheelchair hence it is necessary to make a comfort wheelchair for them with push back mechanism and easy handling and When the lever is pushed outward the linkage will engage and tends to steer the wheel right side. When the lever is pushed inward due to the action of the linkage then it tends to steer the wheel left side. And that which guide the wheelchair at desired direction. The Motor to be turned on by switching on the battery supply that which are connected with 9-way switch and so that the Bevel gears that which mounted on the motor shaft transmit motion to gear mounted on the shaft and that which used to transmit the power at constant velocity between the shafts whose axes intersect at a certain angle and due the rotation of shaft motorized wheelchair tends to move forward and backward by using 9-way switch that which connected with motor and battery in the wheelchair.

RESULT:

As we had discussed earlier about both the Motorized and manually operated wheelchair, now we a quite very much know about its function and estimation of it. Hence the little bit changes have made in the evolution of the wheelchair which already exist. Therefore by considering that the manually operated wheelchair finds difficult in self propelling by a patient and also he is always in the dependency of some other person On the other hand, by considering the motorized wheel chair which is very much costlier than the manual wheelchair, but the control is given by joystick which is very much cost. Therefore by considering the people who find it difficult in buying the automated wheelchair, slight difference in the automated wheelchair have been evolved. We tried to reduce the cost of the wheel chair in the optimal ratio which will be helpful for the poor people.

CONCLUSION:

The main aim of this project is to satisfy the need of common people to use automated wheel chair at an affordable cost. Although the manual wheelchair is less cost but the patient will always seeks the help from another person or he will be a dependent person on another person. The patient will find difficult in the self-propelled manual wheelchair because of its own weight. To have an automated wheelchair, many people find difficult in buying, due to its high cost. A cheaper automated wheelchair will be the dream of the poor people, hence this low cost automated wheelchair with the mechanism controlled will meet the need of the people.

REFERENCES:

[1]. Machine Design book by R S Khurmi, and J K Gupta.

[2]. Design Data book compiled by PSG College of Technology, Coimbatore, Page no. 7.21, 4.2, 4.4.

[3]. A review on Smart Wheelchairs Richard C. Simpson, PhD, ATP*, Department of Rehabilitation Science and Technology, University of Pittsburgh, Pittsburgh, PA.

[4]. Snehlata Yadav, Poonam Sheoran, "International Journal of Innovative and Emerging Research in Engineering", Volume 3, Issue 2, 2016.

[5]. Gurjot Singh Gaba, Paramdeep Sing and Sandeep Kumar Arora, "Indian Journal of Science and Technology", Vol 9(21), June 2016.

[6]. Tadakamalla Shanmukh Anirudh, Jyoti Pragyan Satpathy "Journal on motorized wheel chair, National Institute of Technology", Rourkela Issue: 2011.

[7]. Finlayson M, Van Denend T., (2003), Experiencing the loss of mobility: Perspectives of older adults with MS. Disabil Rehabil.; 25(20): 1168-1180.