
Fabrication of Advanced Wheelchair cum Strecher

Rajeev V.R*, Ramjith Krishnan R**, Prof. K Gopalakrishna Pillai***

*Assistant Professor, Archana College of Engineering Alappuzha, India

**Assistant Professor, Vidya Academy of Science and Technology Technical Campus, Trivandrum, India

***Professor, Sarabhai Institute of Science & Technology, Trivandrum, India

ABSTRACT:

Wheelchair is the most commonly used mobility aid used especially by amputees and those affected by lower extremity paralysis. These wheel chair bound handicapped always need external help when they have to lie down for taking rest. Most of the sophisticated electric wheel chairs available in the market are costlier and do not facilitate lying down for rest. So there was a need for an advanced patient friendly wheel chair system. There are mainly two types of wheel chairs; manual and electric wheel chairs. Electric or powered wheels chairs are self-propelled type wheel chairs which uses electric motors for tractions. This indigenously designed advanced wheel chair cum stretcher was taken up as a B. Tech final year project. It consists of a driving unit, steering unit, lifting unit and power supply in addition to the parts of a normal wheel chair. With electrically powered motors and patient friendly controls the wheelchair can be converted to a stretcher by disabled at will. The driving or traction unit is used for forward and backward movement of the wheel chair, while the steering unit is used for turning. The lifting unit change the front leg support and back rest into a stretcher. A common power supply is used for all the above units. Ergonomically placed control switches can be activated by the person both in sitting and laying modes.

INRODUCTION

Wheelchair is a type of mechanical device that is used to improve the accessibility of persons who are mobility challenged. Wheelchair comes in variation where it is propelled by motor or by seated occupants turning rear wheel by hand. Often there are handles behind seat for someone else to do pushing. Based on this, wheelchairs can be classified as electric wheelchairs or manual wheelchairs. The occupants spent a lot of time in sitting position since he cannot move and lie down himself in a bed. Transferring a person from this type of wheelchair to bed is also difficult. Even the sophisticated type of wheelchair available in the market today does not have the provision to lie down. This prompted us to think about a wheelchair which can be converted to a stretcher or as a bed by the aid of power, so that the occupant himself can convert wheelchair into a stretcher and rest.

DESIGN CONSIDERATIONS

The main design considerations that while developing advanced wheelchair cum stretcher are

1. Easiness to handle
2. Stability in both wheel chair and stretcher mode
3. Easiness to transfer patient from bed to wheelchair and from wheelchair to bed
4. Conversion from wheelchair to stretcher mode and back

5. Simple mechanism to convert wheelchair to stretcher and back to wheelchair automatically by the person who is using the wheel chair
6. User friendly controls
7. Safety



Fig 1:ADVANCED WHEELCHAIR CUM STRETCHER

DESCRIPTION

The main parts of advanced wheelchair cum stretcher (AWCS) are driving unit, steering unit, lifting unit, control unit and the power supply. This systems are suitably placed on a chassis designed to meet the stability criteria. The driving unit is used to move the wheel chair forward and backward. Steering unit is used to turn the wheelchair, the lifting unit is used to convert the wheelchair to stretcher and back to wheel chair. The control unit is used to control the function of driving, steering and lifting units. Power supply is used to supply power to run these units.

CHASSIS

Chassis is designed so as to hold all the parts of the wheelchair. The chassis is made of GI pipes. Footrest and backrest are hinged to the main chassis so that it is rotated about the hinge joint to convert from wheelchair mode to stretcher mode and back.

DRIVING UNIT

The driving unit is used to move the wheelchair forward and backward. The main parts of the driving unit is the drive motor and the control circuit, the drive motor is a 24v, 300W PMDC motor with gear box connected to it. The output speed that is obtained from the gear

box is 100rpm. The control circuit is used to change the direction of movement of the motor shaft. DC motors have the property that if the polarity of the voltage applied to the motor is changed then the direction of turning of the motor shaft will also change. Relay control is used to change the polarity of the voltage applied to the drive motor.

STEERING UNIT

Steering unit is used to turn the wheelchair. The main parts are the steering motor and the steering mechanism that is connected to the front caster wheels. The control circuit is also used to control the steering motor. Since the wheelchair runs at low speeds we have selected Ackerman's steering mechanism for AWCS.

LIFTING UNIT

Lifting units are used to make the wheel chair to stretcher and back to wheel chair. The main parts of the lifting mechanism are the powered screw jack and the control circuit. There are two powered screw jacks one is connected to the footrest and the other to the backrest.

CONTROL UNIT

Control unit is used to control all the parts of the wheelchair. The control panel is connected to the control unit. The control panel is placed in such a way that it can be easily assessed by the person who is using the wheelchair both in wheelchair and stretcher mode.

POWER SUPPLY

The power to drive the wheel chair is supplied by two 12v, 35Ah batteries. Charging circuit is also provided to charge the batteries and also a charge level indicator is provided in the control panel to know the amount of charge. The batteries can be recharged by connecting the power supply cord provided in the wheelchair to main supply

DESIGN

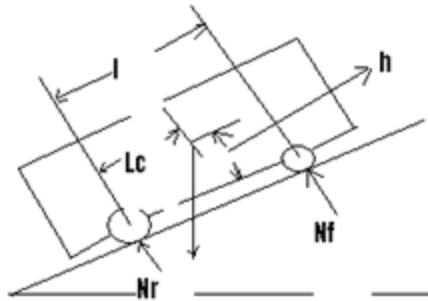
DESIGN OF CHASIS

Design of the chassis is done in such a way to with stand the load and to make it stable both in wheelchair mode and stretcher modes. The design of the frame is done by considering a pay load of 100kg. Provisions are made on the chassis to fix the footrest and back rest by hinge joint. The footrest and backrest are hinged to the chassis, brass bushes are provided for the smooth movement of foot rest and back rest. To make the wheelchair stable both in wheelchair mode and stretcher mode the centre of gravity (CG) is calculated, the position of different parts are to make the CG in the centre position and as low as possible. The CG in the wheelchair mode is $(x=0.34, y=0.72, z=0.32)$ m and CG in the stretcher mode, is $(x=0.34, y=1.2, z=0.41)$ m. The material selected for making present model is GI pipe based on the load on each member and the diameter is calculated. In order to make the load distribution on both side of the wheelchair equal, pipes of 25mm diameter are provided on

both sides. Based on these calculations, a 3-D drawing of the wheel chair is made on pro-e software. The finalised drawing of the model is prepared for fabrication.

DESIGN OF DRIVE MOTOR

CALCULATION OF TRACTIVE FORCE



Taking vertical components of forces

$$N_r + N_f - F_m \cos \theta = 0$$

$$N_r + N_f - 160 \times 9.81 \times \cos 15 = 0$$

$$N_r + N_f = 1516.11 \text{ N}$$

Moment about r

$$F_m \times h \times \sin \theta + N_f \times L - F_m \times L_c \times \cos \theta = 0$$

$$160 \times 9.81 \times .52 \times \sin 15 + N_f \times .6 - 160 \times 9.81 \times \cos 15 = 0$$

$$N_f \times .6 = 747.3$$

$$N_f = \underline{1245.5 \text{ N}}$$

$$N_r = 1516.11 - 1245.5$$

$$= \underline{271.1 \text{ N}}$$

TORQUE

$$T = N_r \times \text{radius of the wheel}$$

$$= 271.1 \times .12$$

$$= 28.92 \text{ Nm}$$

POWER OF MOTOR

$$P = \frac{2 \times 3.14 \times N \times T}{60}$$

$$= \frac{(2 \times 3.14 \times 90 \times 28.92)}{60}$$

$$= 267.4 \text{ W} . \text{Hence a 300 W motor is selected.}$$

Table 1: Specifications

| | |
|--|----------------------------|
| Max load capacity | 100kg |
| Max speed | 1 m/s |
| Torque | 28Nm at 100rpm |
| Drive motor | 24v 300W PMDC motor |
| Wheel to wheel distance | 1.1m |
| Width | 0.6m |
| Net weight | 45kg |
| Total length in stretcher mode | 1.9m |
| Total length in wheel chair mode | 1.2m |
| Steering motor | 12v 26W PMDC motor |
| Lifting motor | 12v 36 w PMDC motor |
| Power supply | 230v (main supply) |
| Batteries | 12v 35Ah batteries (2 nos) |
| Full charge time | 8 hrs |
| Max usage time between periodic charging | 5 hrs (continuous usage) |

OPERATION OF ADVANCED WHEELCHAIR CUM STRETCHER

AWCS has two modes of operation namely wheelchair mode and stretcher mode. Switches are provided in the control panel to move and turn the wheel chair in the wheel chair mode. Switches are also provided to make the wheel chair to the stretcher mode and back.

How to operate?

Step 1- Adjust the position of the control panel in a convenient position so that it can be operated both in wheelchair mode and stretcher mode.

Step 2-Switch on the power switch and see whether the power LED is on. If the power LED is not on then check whether emergency is on.

Step 3- If the emergency switch is on then switch off it. Now the power LED will be on, at the same time the charge level indicator will indicate the level of charge in the battery. Now the AWCS is ready to use.

Step 4- Use switches for the movement of the wheelchair, provided at the top of the control panel. Switches are also provided for forward or backward movement and to turn AWCS to right or left by the occupant.

Step 5- For converting wheelchair to stretcher and back to wheelchair switches are provided at the front side of the control panel. Separate switches are provided to control the movement of footrest and backrest.

ADVANTAGES AND DISADVANTAGES OF AWCS

Advantages of AWCS

- (1) Self-propelled wheelchair
- (2) Less costlier
- (3) Can be use both as wheelchair and stretcher
- (4) Is compactable with solar energy
- (5) Need no brake system
- (6) Chain drive system has maximum efficiency

Disadvantages of AWCS

- (1) The wheelchair is bulky
- (2) Cannot be moved without power

MAINTANANCE

The main maintenance procedures that has to be done for the proper working of advanced wheelchair cum stretcher are

1. All the moving parts should be periodically lubricated
2. Proper maintenance and checkup of the batteries should be done every year
3. Try to recharge the batteries every day

FUTURE IMPROVEMENTS

Few of the proposed improvements for the current design are

1. Height adjustment
2. Remote operation and incorporation of fault alarm
3. Variable speed control with joy stick
4. Better control circuit with object sensors to sense hindrance in the path for safety
5. Use of alloy materials to reduce weight
6. Testing and optimising the overall design in order to make it more ergonomic and low weight
7. Provide an option to control the wheel chair manually

CONCLUSION

The advanced wheelchair cum stretcher is designed, fabricated and tested. The developed system is a low cost option when compared to other wheel chairs in the market for lower extremity paralysis patients to lie down and rest at will. Therefore the physically disable person can move and rest on the wheel chair itself without any external help and cost is very much less than the electrical wheel chairs available in market

REFERENCES

- i. www.wheelchairpower.com
- ii. [www.electric-wheelchair-on.net/-](http://www.electric-wheelchair-on.net/)
- iii. www.spinlife.cow
- iv. www.freepatentsonline.com
- v. www.b2bchinasources.com
- vi. Machine Design by R.S.Kurumi
- vii. Design Data Book

WWW.IJESTA.COM