

Structural Design of Wheelchair with Auxiliary Transfer Function

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Abstract

China has gradually entered an aging society. At present, the function of wheelchair in the market is generally single, which can not meet the needs of the elderly in daily life. This paper designs a multi-functional home care environment barrier free wheelchair, according to the needs of wheelchair functional structure design, in order to achieve barrier free transfer in the home environment between nursing bed, sofa, bathroom and car, with the help of nursing staff, a convenient home care mode is established.

Keywords

Assisted Transfer; Wheelchair; Structural Design.

1. Introduction

At present, China has entered an aging society. How to protect the family care of the elderly and disabled has become a social problem to be solved [1]. With the progress of science and technology, products for the elderly are developing in the direction of intelligence and multi-function, such as voice control, visual control, remote control etc. However, in view of the current social situation of China, the elderly who need to help are not rich, and most of them have no ability to purchase the multi-functional and high intelligent products for the elderly. Although, there are many types of wheelchairs in China, but its functions are generally single, which can not meet the needs of the elderly at home. The development of multi-functional wheelchair equipment for the elderly can effectively improve the quality of life of the disabled elderly, liberate the labor force of nursing staff, and realize various barrier free transfer in the home environment, such as nursing bed, sofa, toilet, family car and climbing stairs, which has important research value and social significance.

Since the first wheelchair was invented, a lot of researches were carried out on wheelchair equipment. The early research mainly focused on the basic functions of wheelchair. Wheelchair equipment has experienced the evolution from human mechanical type to electric wheelchair driven by motor, and then to multifunctional wheelchair with climbing, lifting, lying flat and folding. At present, electric wheelchairs can be divided into the following four categories according to their common functions:

1.1 Climbing wheelchair

Generally speaking, there are three types of climbing wheelchair: track type, star wheel type and walking type. Taking the star wheel climbing wheelchair as an example, the climbing mechanism is composed of planetary gear train structure. When walking on the ground, the planetary gear rotates, while climbing the stairs, the planetary gear revolves around the tie rod. IBOT made in the United States is the best star wheel climbing wheelchair at present, but this kind of wheelchair is often expensive [2-4].

1.2 Lift wheelchair

Because it is difficult for the disabled elderly to complete the transfer from bed to wheelchair alone, they will encounter many inconveniences in life. The use of a lift wheelchair can solve these problems. As shown in Figure 2, the user lifts up and down in a wheelchair. The working principle of this type of electric wheelchair is to install an electric cylinder under the seat to realize the rise and fall of the seat. Due to the small area of the push rod, when the center of gravity deviates too much, the wheelchair may overturn[5].



Organization of the Text (a) track type (b) star wheel type (c) walking type

Figure 1. Climbing wheelchair



Figure 2. Lift Wheelchair



Figure 3. Flat and adjustable wheelchair

1.3 Flat adjustable wheelchair

As shown in Figure 3, Considering that long-term sitting in wheelchair will increase the burden of pelvis and iliac joint, in order to relieve the pressure on the back and buttocks of the users, the flat lying adjustable wheelchair appears on the market to solve the above problems .

This project plans to design a wheelchair with auxiliary displacement function, easy to carry and store. The design can transfer the disabled from wheelchair to nursing bed, sofa, toilet and family car with the help of nursing staff. The wheelchair design is divided into four modules: chair frame module, auxiliary shift module, rapid disassembly module and chair seat module. The shift module is connected with the chair frame module through the sliding track and buckle device. The lifting device of the shift module is a hydraulic push rod, which is connected with the quick release module and the seat module[6].

This project is to design a wheelchair with auxiliary displacement function, a wheelchair which is convenient to carry and easy to accept and can transfer the elderly, leg and foot injuries and disabled people from the wheelchair to the nursing bed, sofa, toilet toilet, family car assisted displacement, which can be moved with the assistance of nursing staff. The function design of multi-scene multiplication and shift is carried out to realize the automation of bed rest elderly and patient shift, and the operation is convenient, thus effectively reducing the handling pressure of nursing workers. According to the relevant requirements of the auxiliary transfer wheelchair, it can realize all the movement requirements required by the shift, such as the lifting of the wheelchair and the lifting of the legs. At the same time, the designed auxiliary transfer wheelchair can be easily and quickly disassembled and folded.

2. Working principle

2.1 Working principle analysis of chair frame module

Chair frame module includes 1. backrest; 2, main chair frame unit; 3, chair frame slot mechanism; 4, detachable guide rail connection key; 5, chair frame rear wheel; 6, chair frame action wheel; 7, pedal; 8, detachable guide rail. The lower part of the main chair frame unit is provided with a connecting sliding guide rail, the guide rail is provided with a clamping groove mechanism, the clamping groove part is provided with a limiting device, the front end of the sliding guide rail is provided with a connecting groove, and the detachable guide rail is provided with a connecting key, which can be quickly connected with the sliding guide rail; the main chair frame unit includes two, two The main chair frame unit is symmetrically arranged on the left and right sides. A connecting rod is arranged between the two main body chair frames. The connecting rod has two rotatable rods which are fixed together by hinges. The two connecting rods can be rotated into a "one" structure. The other end of the connecting rod is respectively fixedly connected with the left and right main chair frame units. The rear end of the main chair frame unit is provided with a big wheel, and the front part is provided with a small action wheel, as shown in Figure 4.

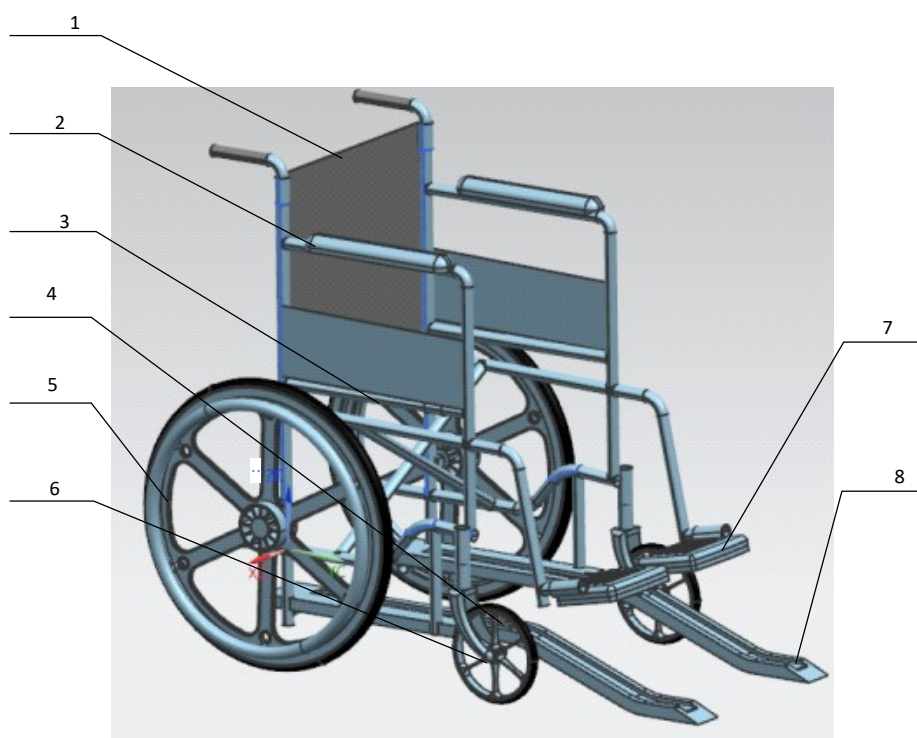


Figure 4. (1, Backrest; 2, main chair frame unit; 3, chair frame slot mechanism; 4, removable guide rail connection key; 5, chair frame rear wheel; 6, chair frame action wheel; 7, pedal; 8. removable guides.)

The steps of folding wheelchair frame module is as follows: In the chair frame module, the left and right parts are hinged together through the connecting rod. When folding is required, the shift module and the chair frame module should be separated according to the above steps. At this time, the nursing staff can squeeze from the armrest on both sides of the wheelchair frame to complete the folding when the two sliding rails under the wheelchair frame contact.

2.2 Working principle analysis of auxiliary shift module

Auxiliary shift module includes auxiliary shift module includes lifting module and rotating module. The lifting module adopts an electric push rod device. The lower part of the electric push rod is placed in the strip type clamping slot on the bottom rotating platform, and is positioned by two clamping bolts. The upper part of the electric push rod is connected to the seat module through a quick disassembly device. The rotating module is composed of a base, a bearing and a rotating platform, and a groove is arranged on the base and the rotating platform to put the bearing into the groove. On the base plate of the shift module, a pair of universal wheels with variable direction brake are arranged symmetrically at the rear, and a pair of steering wheels with guiding effect are arranged symmetrically at the front, as shown in Figure 5.

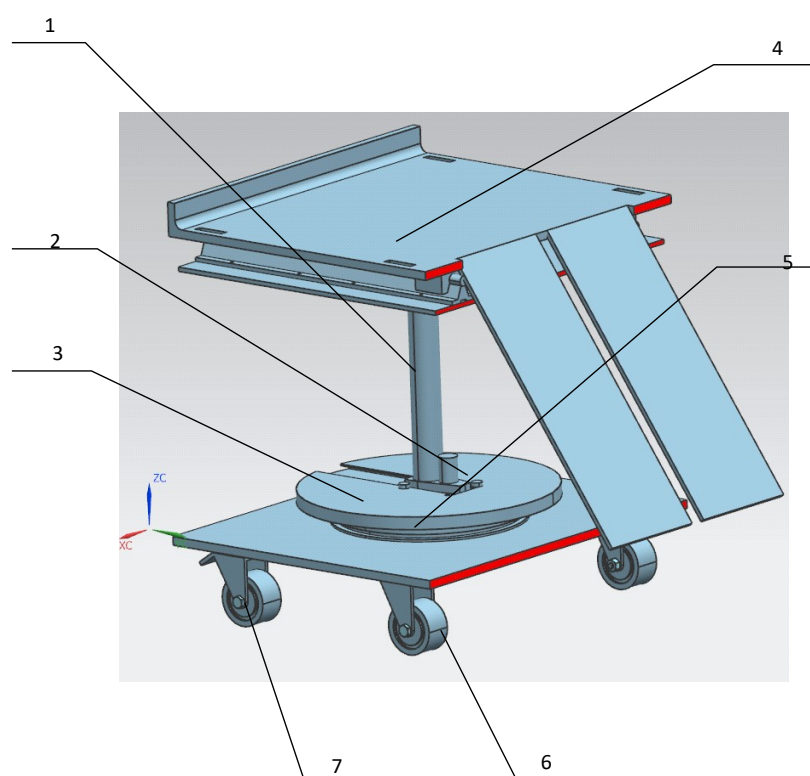


Figure 5. Auxiliary Shift Module

1. electric push rod device; 2, clamping bolt; 3, rotating round table; 4, chair seat module;
5, rotating bearing; 6, shift module guide wheel; 7, shift module universal wheel.

The steps of auxiliary shift module is as follows:

(1) The nurses operate the wheelchair with auxiliary displacement function to walk to the place near the transfer of sofa, toilet or car, operate the brake mechanism of wheelchair frame to stop the wheelchair, turn the foot pedal to the upright state to prevent interference with the shift module, open the connecting buckle in the groove of the seat seat module to separate the transfer device from the main chair frame unit.

(2) The nursing staff installed the detachable guide rail to the lower connection slot of the chair frame module, opened the brake device of the wheel on the bottom plate of the shift module, and pushed the shifting device to slide down along the track, so as to separate the main chair frame unit from the shift module.

(3) The nursing staff manipulated the shift module to the transfer seat, pressed the brake mechanism of the lower plate of the shift module, and turned the rotary plate of the shift module, so that the back of the passenger was facing the seat. At this time, the nursing staff can adjust the height of the electric push rod to the appropriate position. After the height is determined, the sliding guide rail of the chair seat module can be used to realize the translation of the seat plate along the guide rail, and the seat plate can be extended into the vehicle seat to complete the displacement.

(4) At this time, the nursing staff can easily transfer the passenger into the car, and then operate the shift device to return to its original position.

Quick disassembly and assembly steps of auxiliary shift module:

(1) The nursing staff should first open the pressing handle of the quick release device under the seat module to loosen the opening sleeve. At this time, the lifting rod is separated from the base plate of the seat module, and the nursing staff can separate the seat module from the lifting mechanism.

(2) The nursing staff need to pull out the positioning bolt on the rotary table, and then push the lifting device out along the long card slot on the rotary platform to complete the separation of the lifting rod and the rotating platform.

2.3 Quick disassembly module

The quick disassembly module includes annular opening sleeve, pressing handle, connecting screw and rubber gasket. The bolt connects the opening sleeve and the pressing handle. The tightness of the opening sleeve is controlled by the pressing handle. The opening sleeve is connected with the chair seat. The lifting module and the seat module can be quickly separated by controlling the tightness, as shown in Figure 6.

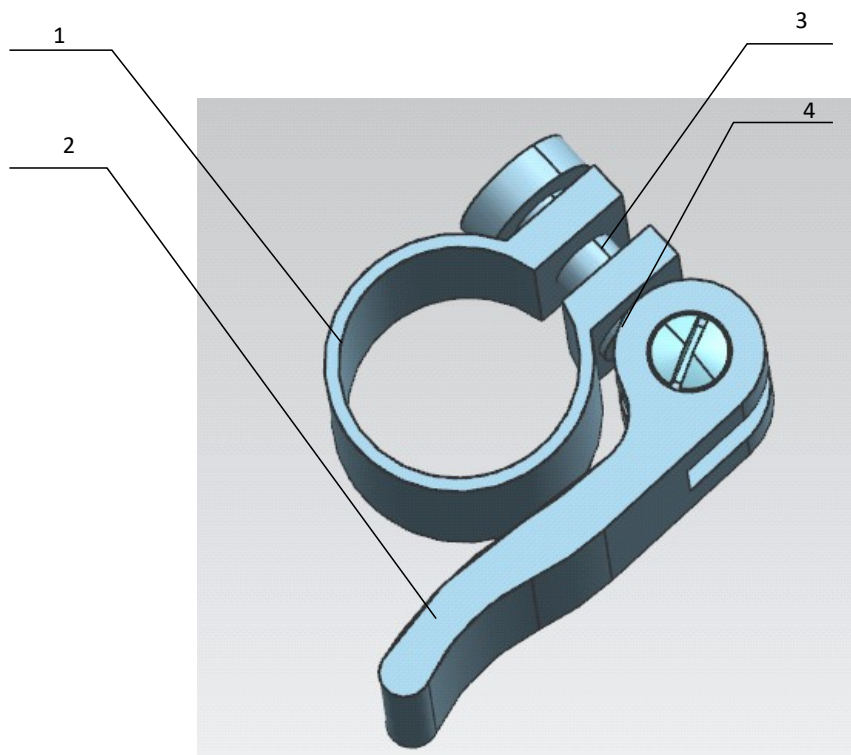


Figure 6. Quick disassembly module

1. Opening sleeve; 2. Pressing handle; 3. Connecting screw of quick release device; 4. Rubber gasket of quick release device.

2.4 Seat module

The chair seat module includes a seat plate, a seat plate base, a guide rail, a sliding block and a rotatable front plate, as shown in Figure 7.

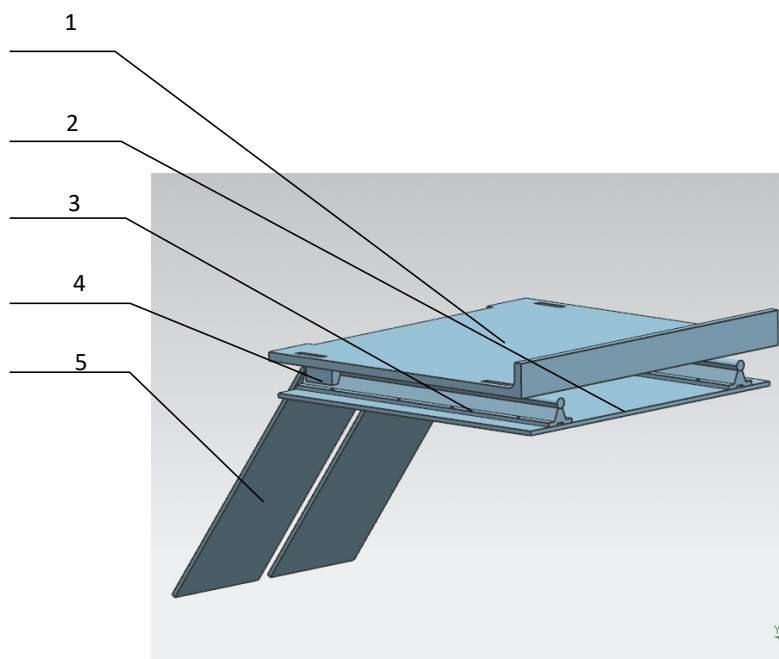


Figure 7. Seat block module

1.Seat plate; 2. Seat base; 3. Seat slide; 4. Seat slide; 5. Rotating front plateb.

A connecting hole is arranged on the seat plate base, the guide rail is connected with the seat plate base, the sliding block and the guide rail are combined with each other, and the sliding block mechanism is connected with the seat plate. The seat plate can slide along the guide rail driven by the sliding block, and the side of the seat plate is provided with a buckle groove to connect with the wheelchair frame module. The front part of the seat plate is provided with a square opening groove which is hinged with the rotatable front plate to realize the rotation of the front plate.

3. Conclusion

This paper mainly designs the structure of the wheelchair with auxiliary shift function, including chair frame module, auxiliary shift module, rapid disassembly module and chair seat module. According to the functional requirements of each module, the specific structure and working principle of the four modules are determined to meet the expected design requirements.

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