

The Innovative Design of Wheelchair with Lifting and Standing Functions

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Abstract

Traditionally, the mechanism of wheelchair with lifting and standing functions has 2 degrees of freedom, and used 2 power sources to perform these 2 motion function. The mechanism proposed for wheelchair with lifting and standing functions in this paper has 1 degree of freedom. Hence, we can use only 1 power source to drive the mechanism to achieve lifting and standing functions. For traditional standing wheelchair, its' center of gravity moves forward when standing up and it needs 2 auxiliary wheels to prevent dumping. In this paper, by using the checklist method of Osborn, the wheelchair with 1 DOF is invented to perform lifting and standing functions. The center of gravity of this new wheelchair after standing up still located between the front and rear wheels, no auxiliary wheels needed. The new design has the advantages of simple operation, more stability, and more safety.

Keywords: Checklist method, innovative design, wheelchair with lifting and standing functions

1. Introduction

Wheelchair is an important assisted vehicle for the disabled person for body moving and participating social activities. With the progress of sociality, the demands of wheelchair are more and more diversified. Hence, the standing up [1], lifting up [2], lying down [3], tilting down [4], and multi-function [5] wheelchairs are invented to satisfy the disabled person's need. Figs. 1(a)-1(d) show the wheelchairs with standing, lifting, lying, and tilting functions. This paper focuses on the innovative design of wheelchair with lifting and standing functions.

Currently, the mechanism of wheelchair with lifting and standing functions has 2 degrees of freedom, and used 2 power sources to perform these 2 motion function. The 1st purpose of this paper is to invent mechanism with 1 degree of freedom (DOF) to perform lifting and standing functions. Hence, we can use only 1 power source to drive the mechanism to achieve lifting and standing functions. According to Fig. 1(a), for the traditional standing wheelchair, its' center of gravity moves forward when standing up and it needs 2 auxiliary wheels to prevent dumping. The 2nd purpose of this paper is to improve the above problem.



Fig. 1 Functional wheelchair

By referring to such related patents [1-5], the studies on kinematics of mechanisms [6-8], and the studies on the creative design [8-10], we synthesize a mechanism with 1 DOG to perform the lifting and standing functions. The center of gravity of this new wheelchair after standing up and tilting down still located between the front and rear wheels, no auxiliary wheels needed. Hence, the new design has the advantages of simple operation, more stability, and more safety.

2. Osborn's Check-List Method

The checklist is the simplest method for problem solving. It is a method that provides hints by checking the items on a prepared list against the problem. In design terms, a checklist is a set of questions that can be asked about any project in an attempt to stimulate ideas.

Osborn was called originator of modern creative science. He proposed many creative methods; one of them is Check-list method. In his book "Applied Imagination", he listed 83 questions that could be used to check for creativity. Professor Dior of Harvard University summarized Osborn's 83 questions to 9 items. The common 9 items are : 1. Reverse, 2. Transfer, 3. Combine, 4. Change, 5. Extend, 6. Enlarge, 7. Reduce, 8. Substitute, 9. Rearrange. When we use of Osborn check-list method to create new ideas and designs, we have to make sure that the creations could make advantages instead of just for invention. Therefore, we must make the innovation which can bring better performance than current status.

3. Innovative Design

The 1st purpose of this paper is to invent mechanism with 1 degree of freedom (DOF) to perform lifting and standing functions. According to Fig. 1(a), for the traditional standing wheelchair, its' center of gravity moves forward when standing up and it needs 2 auxiliary wheels to prevent dumping. The 2nd purpose of this paper is to improve the above problems. In this paper, we use Osborn's check-list method to design the wheelchair having standing and tilting functions.

3.1. Design Requirements

The requirements of the mechanism for wheelchair with standing and tilting functions are:

1. The mechanism of wheelchair has 1 degree of freedom.
2. The lifting and standing functions can be achieved by using only 1 power source.
3. The center of gravity of this new wheelchair after standing up still located between the front and rear wheels, no auxiliary wheels needed.

3.2. Chick-List method

Here, we adopt the transfer, combine, and reduce methods of Osborn check-list method to

design the wheelchair with lifting and standing functions. Fig. 2 shows a mechanism with 1DOF which is the result of innovative design. This new mechanism can perform the lifting and standing functions.

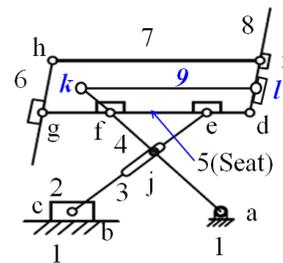


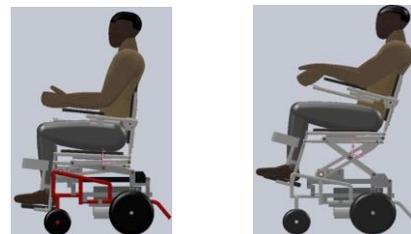
Fig. 2 New mechanism for multi-function wheelchair

The new mechanism will have 9 links and 12 joints (including 1 cam pair j), i.e. $J_1=11$ and $J_2=1$, its' degrees of freedom can be written as:

$$F=3(N-1)-2J_1-J_2=3(9-1)-2(11)-1=1 \quad (1)$$

where F is the degree of freedoms, J_i is the number of joints with i degree of freedom.

3.3. Engineering Design



(a) low seated

(b) high seated



(c) standing position

Fig. 3 Wheelchair with lifting and standing functions

According to Fig. 2, the corresponding 3D drawing of the wheelchair is completed by using the software "Solid Works." Figs. 3(a), 3(b), and

3(c) show the corresponding diagrams of multifunctional wheelchair at lower seat position, high seat position, and standing position.

4. Conclusions

Traditionally, the mechanism of wheelchair with lifting and standing functions has 2 degrees of freedom, and used 2 power sources to perform these 2 motion function. This invention "Wheelchair with One Degrees of Freedom to Perform Lifting and Standing Functions" has two characteristics: 1. The mechanism of wheelchair is a mechanism with 1 degree of freedom, 2. The wheelchair is driven by 1 power source to achieve lifting and standing motion functions, 3. The center of gravity of this new wheelchair after standing up (or lifting up) still located between the front and rear wheels, no auxiliary wheels needed. The results of this paper can be used as a reference for engineering to design the functional wheelchair.

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