Development of an intelligent robotic wheelchair

Purpose

Mobility is one of the fundamental requirements of the quality of life of the older adults. Observing older adults with low mobility living in a nursing home or in home environment, the wheelchair is the place where they spend most of their time in everyday living. For older adults who cannot move a manual wheelchair themselves, the situation is endless waiting and a loss of vitality. Using an electrical wheelchair is one option. However, operating an electrical wheelchair is often difficult\(^1\). This paper describes the development of an intelligent robotic wheelchair (iRW) which integrates advanced robotic and telehealth solutions. In addition to providing mobility assistance, the iRW also attempts to integrate and satisfy the needs of everyday living, healthcare, and social participation.

Method

The iRW (Figure 1) is composed of a moving vehicle, a sensing/control module and an information/communication module to provide mobility aids and to support everyday living and healthcare. Equipped with 4 Mecanum wheels, the user can freely control the iRW in all directions, including moving sideways. In addition to manual control, an automated guided vehicle (AGV) type indoor navigation system based on quick response code (QR code) can guide the iRW move from site to site automatically. Besides, the multiple degrees-of-freedom seat adjustment mechanism based on Stewart platform\(^2\) and the ergonomically designed seat enable relaxed sitting in preferred postures, as well as lifting and transfer assistance. Equipped with soft pressure sensors, the seat also provides automatic pressure relief function by timely adjusting the seat mechanism. Moreover, the

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telehealth system in the form of a digital photo frame running on a tablet PC serves as the platform of health care management and as the information channel between the wheelchair user and his family or caregivers[3].

Figure 1. The prototype of the iRW

Results & Discussion

To prepare a field test for the iRW confirming the usability and praxis capability, 20 healthy adults participated in a laboratory evaluation. This evaluation was based on several typical tasks of everyday living on a wheelchair, in order to compare the differences in usability between a manual wheelchair and the iRW. In the user-satisfaction questionnaire, participants rated all functions, including operation interface, maneuverability, seat adjustment, etc., from 5 (totally satisfied) to 1 (totally not satisfied). Operation time of each task was also measured. The results show that the time of exploration using the iRW for each task was similar or longer. But concerning the user-satisfaction of mobility assistance and seat adjustment, the testers were satisfied with most of the functions provided by the iRW. The peak seating pressure of the iRW, which has versatile seat adjustment capability, was only half of that of the manual wheelchair. According to the results of the laboratory evaluation, the iRW has a good potential to help the older adults interact with the home environment more effectively and actively, while improving the quality of life.

Keywords: robotic wheelchair, indoor navigation, Stewart platform, home telehealth system.
References

