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Resonance Assistance and Custom Transmission for Lever-Drive Wheelchair

Tech ID: 24872 / UC Case 2014-925-0

BRIEF DESCRIPTION

The technology is a lever-drive wheelchair. With this device, users are able to drive a wheelchair or exercise using impaired arm. The device contains a custom transmission, flexible arm support, elastic members connected between lever and wheelchair frame, and a counterweight for assistance during use and does not contain actuators or powered components.

FULL DESCRIPTION

This device is a lever-drive wheelchair that is intended to be used as a rehabilitation tool in a clinical setting. It comprises a custom transmission that allows it to be used in a mobility mode or in a stationary exercise mode for increased movement practice. It also contains a flexible arm support, elastic members connected between the lever and the wheelchair frame, and a counterweight to provide assistance during use.

One novel aspect of the invention is the inclusion of the arm support, tensile or elastic members, and counterweight onto a lever-drive wheelchair so that an individual with arm impairment can use it for over-ground mobility. A lever is coupled to the hub of each wheel of the wheelchair through a one-way bearing and a trough that is shaped to hold a user's arm is attached to the lever. Elastic members are attached between the lever and the wheelchair that support the weight of the lever and the user's arm against gravity, while still allowing the forearm to rotate ergonomically. This design creates a resonant system, which amplifies a user's range of motion in the device if they move the lever back and forth at the right frequency. To aid this movement, a counterweight is added to the lever opposite the arm support trough, increasing the inertia of the lever component and lowering the movement frequency. This counterweight also serves to balance the weight of the lever and further support the lever and arm against gravity, making it easier for an individual with severe impairment to use the device.

The mechanical resonance of the lever created by the tensile members and counterweight can reduce the amount of force needed to propel the wheelchair forward by 40%. The arm support makes the system safer and more comfortable for individuals with severe arm impairment, and prevents side effects such as shoulder contracture. The elastic bands and counterweight also prevent the lever from applying undue forces to the impaired arm, but rather supports the arm against gravity, again reducing the effort required to use the device.

Another novel aspect of the invention is a transmission and clutch mechanism that allows the one-way bearing to be disengaged so that the lever can rotate independently of the wheel. This allows continued practice of the movements required to drive the chair while the chair remains stationary. The clutch mechanism also incorporates a third mode, which is to directly attach the lever to the wheelchair wheel. In this mode, the user can brake the chair motion or turn the chair by resisting movement of the lever, and can rotate the chair in place by moving the two levers out of phase with each. A grip force sensor can be used by the user to automatically shift the transmission from over-ground mode to braking mode.

There is evidence that intensive movement practice can reduce motor impairment after injuries such as stroke. However, many individuals do not achieve the high number of practice repetitions required to maximize recovery. Robotic therapy devices have been developed for automating therapy, but they are expensive, difficult to use, and require dedicated space in a clinic. Here we propose a lever-drive wheelchair that is designed for rehabilitation of the upper extremity. Other lever-drive wheelchairs have been invented, but they are intended as mobility tools in the community. Therefore, they do not provide appropriate

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OTHER INFORMATION

CATEGORIZED AS

- » **Engineering**
 - » Engineering
- » **Medical**
 - » Devices
 - » Diagnostics
 - » Rehabilitation
- » **Transportation**
 - » Alternative Propulsion
 - » Personal

RELATED CASES

2014-925-0

assistance for individuals with motor impairments to use them for rehabilitation exercises.

SUGGESTED USES

- » Rehabilitation tool in a clinical setting
- » Rehabilitation tool for patients with arm impairment

ADVANTAGES

- » Allows for patients with impaired arm to maneuver themselves in the wheelchair or exercise in place
- » As a rehabilitation device, the lever-drive is less expensive than many robotic devices because it does not contain any actuators or powered components
- » It can be a one-for-one replacement of the traditional manual wheelchairs currently used in rehabilitation clinics

PATENT STATUS

Country	Type	Number	Dated	Case
United States Of America	Issued Patent	9,597,241	03/21/2017	2014-925

PUBLICATIONS

The Resonating Arm Exerciser: design and pilot testing of a mechanically passive rehabilitation device that mimics robotic active assistance

Lever-actuated resonance assistance (LARA): a wheelchair-based method for upper extremity therapy and overground ambulation for people with severe arm impairment

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