Short Communication
Volume 7:10, 2022

Journal of Physiotherapy & Physical Rehabilitation

ISSN: 2573-0312

Open Access

Robot for Ankle Rehabilitation Made of Nitinol: Gamification and Control

Julian Grayson*

Department of Cardiothoracic Surgery, Presbyterian Hospital, New York, USA

Introduction

Ankle rehabilitation exercises can be repetitive and monotonous. The utilization of robots and games can supplement the current practices, give a connecting with climate to the patient and reduce the physiotherapist's responsibility. An ankle rehabilitation robot with two nitinol wire actuators and a Pong game is presented in this paper to perform plantarflexion and dorsiflexion exercises on the feet. Nitinol is a type of smart material that can produce translational motion and has a high volumetric mechanical energy density. To control the actuators, a two-state discrete antagonistic control is suggested. Both healthy participants and stroke patients were used to test the system. The outcomes demonstrated that the robot complied and was secure. When the participant applied an opposing force, the robot did not firmly plantarflex or dorsiflex the foot. In order to flex to the foot in accordance with the up-and-down motions of the player's bat during the game, the actuators functioned antagonistically. These actions demonstrated that interactive rehabilitation exercise could be provided by a nitinol-based ankle rehabilitation robot and an easy-to-understand game. The robot is expected to quantitatively track the patient's recovery progress and improve the patient's experience, participation and compliance with the rehabilitation routine.

Description

The treatment of ankle rehabilitation is time-consuming, costly and requires commitments from both patients and physiotherapists. The physiotherapist must manually assess and carry out the repetitive rehabilitation routine and the patient must actively participate in and follow the prescribed treatment. However, depending on the therapist's knowledge and experience, the assessment may be subjective. The ankle rehabilitation robot has a number of advantages and can overcome these limitations. In one system, the robot can provide both passive and active rehabilitation exercises, among other types of exercise. It can also provide a plethora of data that can be used to aid in diagnosis, prognosis, patient compliance with treatment and record maintenance. Last but not least, it lightens the load on physiotherapists, allowing them to concentrate on performance monitoring and strategy without having to worry about the insignificant aspects of rehabilitation. There are two main categories of ankle rehabilitation robots: wearable and platform robots. The platform robots are stationary robots with a platform that can be moved. These robots usually have a lot of weight and need a lot of space to store and use. Rutgers Ankle, CARR (Compliant Ankle Rehabilitation Robot), parallel manipulator robots and other robots proposed by are some popular platform robots. These robots cannot be used for gait training because they are stationary. On the other hand, wearable robots are small, lightweight and designed primarily to assist patients in gait training by adjusting their foot orientation [1].

The ankle–foot orthosis (AFO) that was proposed by is one of the most common wearable robots. When it comes to performing stationary knee and ankle rehabilitation exercises, parallel manipulator robots are frequently used. It has a basic and conservative development and can produce development of up to 6 levels of opportunity. The traditional closed-loop kinematic chain method can be used to derive the robot's dynamic behavior, which is well known. Additionally, it has precise movement and a rigid structure; As a result, it is safe for rehabilitation, developed CARR with a torque capacity and reconfigurable workspace to provide two distinct sets of motion: plantar flexion-dorsiflexion, inversion-eversion and internal-external rotation of the ankle are all examples. Ankle plantar flexion dorsiflexion and inversion eversion, a parallel robot with three linear actuators for active, active-assistive and active-resistance exercises and an ankle rehabilitation robot with two pairs of pneumatic artificial muscles were developed. The robot can alter its impedance in response to the user's involvement, reducing the amount of assistance provided by the robot as the user's involvement grows [2].

A new trend in robotics is the use of various materials and actuations. Nitinol (a mix of nickel and titanium), otherwise called shape memory compound, is one of the materials that is being investigated and utilized broadly in delicate robots and restoration robots . It has high ability to weight proportion and the memorable capacity its shape after deformity. Nitinol undergoes a state transition from martensite to austenite at higher temperatures, returns to its original form and exerts a pulling force several times greater than its own weight. It changes from an austenite to a martensite state when the temperature drops in the opposite direction, making it easy to deform by an external force. Nitinol is well-known for its low cooling rate and recoverable strain. The first restriction was circumvented by designing and developing the nitinol wire actuator in the previous work. The actuator can produce a linear displacement of 26 mm thanks to its multiple discs, which increase the strain on the nitinol wire. In order to induce forced convection to the actuator, a proposal for periodic cooling was made and incorporated into the robot. The second limitation is addressed by this strategy. This robot, on the other hand, only has a basic control mechanism and it can only perform passive rehabilitation exercises that keep the feet in dorsiflexion and plantar flexion [3].

In recent years, the use of the game as a rehabilitation tool has gained popularity. Gamification of the restoration exercise can supplement the current practices that regularly include monotonic and monotonous dorsiflexion and plantar flexion at the present length, recurrence and scope of movement (RoM). Related studies demonstrated that gamification of rehabilitation procedures could boost recovery and increase patient participation. An ankle rehabilitation robot with nitinol wire actuators is therefore gamified and controlled in this paper. This work incorporates the classic computer game Pong. The game is easy to understand and simple. The player's bat moves with the foot. The game has a two-state discrete antagonistic control that was proposed and implemented. It changes how the actuators move so that they work together to tilt the robot's foot plate up and down, which causes the foot to dorsiflex and plantarflex. It is anticipated that combining these two approaches will enhance the patient's experience, engagement and compliance with the prescribed rehabilitation program, thereby accelerating recovery [4].

The sections of this paper are as follows: describes the ankle rehabilitation robot's design. It also discusses the robot's gamification and control, as well as

***Address for Correspondence:** Julian Grayson, Department of Cardiothoracic Surgery, Presbyterian Hospital, New York, USA; E-mail: graysonjulian@gmail.com*

Date of submission: 01 October, 2022, Manuscript No. jppr-22-82612; **Editor assigned:** 03 October, 2022, PreQC No. P-82612; **Reviewed:** 10 October, 2022, QC No. Q-82612; **Revised:** 17 October, 2022, Manuscript No. R-82612; **Published:** 24 October, 2022, DOI: 10.37421/2573-0312.2022.07.302

the specifics of the experiment on healthy people and stroke patients. It also talks about the experiment's results and overall performance. It also talks about the robot's strengths and weaknesses, as well as some of the possible ways to overcome them in the future. Given that other robots employ multiple load cells, such as in, this one's use of a single load cell is one of its distinguishing characteristics. The load cell determines the user's intention to move the bat up and down in the game by measuring the force they exert when flexing their foot. The activation of the gastrocnemius and tibialis anterior muscles, which are responsible for the plantar flexion and dorsiflexion of the foot, respectively, is also linked to this information [5].

Conclusion

The electromyogram (EMG), which is susceptible to crosstalk and necessitates the precise placement of the electrode for reliable results, is eliminated by this method. However, if further investigation is required, this may not be sufficient. The robot's incorporation of an electromyogram (EMG) may offer a more comprehensive perspective on the patient's recovery. To track the patient's tibialis anterior and gastrocnemius muscle activation during the game, EMG sensors can be positioned there. Using the approach outlined in, this can be combined with the data gathered by the load cell to ascertain whether the muscles are able to properly flex the foot upward and downward during the rehabilitation exercise. There are mechanical limitations to the proposed robot. While other robots, such as in, can perform foot eversion and inversion, the current design only permits dorsiflexion and plantarflexion. Additionally, the robot is huge and bulky; As a result, it won't work well for mobile rehabilitation.

Acknowledgement

None.

Conflict of Interest

None.

References

1. Zhang, Mingming, T. Claire Davies and Shane Xie. "Effectiveness of robot-assisted therapy on ankle rehabilitation–A systematic review." *J Neuroeng Rehabil* 10 (2013): 1-16.

2. Rodríguez-León, Jhon F., Betsy DM Chaparro-Rico, Matteo Russo and Daniele Cafolla. "An autotuning cable-driven device for home rehabilitation." *J Healthc Eng* (2021).

3. Kim, Sangbae, Cecilia Laschi and Barry Trimmer. "Soft robotics: A bioinspired evolution in robotics." *Trends Biotechnol* 31 (2013): 287-294.

4. Lange, Belinda, Sheryl Flynn, Rachel Proffitt and Chien-Yen Chang, et al. "Development of an interactive game-based rehabilitation tool for dynamic balance training." *Top Stroke Rehabil* 17 (2010): 345-352.

5. Ghassemi, Mohammad, Kristen Triandafilou, Alex Barry and Mary Ellen Stoykov, et al. "Development of an EMG-controlled serious game for rehabilitation." *IEEE Trans Neural Syst Rehabil Eng* 27 (2019): 283-292.

How to cite this article: Grayson, Julian. "Robot for Ankle Rehabilitation Made of Nitinol: Gamification and Control." Physiother Rehabil 7 (2022): 302.