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DEVELOPMENT OF A ROBOTIC WALK ASSISTANT DEVICE FOR ELDERLY AND HANDICAPPED PEOPLE

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Abstract. *This article describes the development of electronic apparatus to help in vertical mobility for user with disabilities in the lower limbs. This apparatus consists on the adaptation of linear actuators in axillary crutches in order to extend and retract the crutch when desired, increasing and decreasing its height. This fact allows the user to sit and rise from a chair, go to the bathroom without help from another person and even climb stairs more easily. The drive of the crutches is done through two buttons in the handle of the right crutch and the communication between then is done by radio frequency. The apparatus has a control system that makes the crutches self regulate if there is some small difference in position between them, always based on the position of the right crutch. The system has a Bluetooth communication with smartphones that use Android platform, it allows enables a better adaptation for user with different heights, since through a mobile app the user inform his height and the system can calibrate the actuators limits in order to keep then always in the better height range. Another important feature of this new model of axillary crutch is that it has a fairing produced in by vacuum forming attributing to the crutches young and modern forms. This fairing can be customizable and easy to exchange, enabling the user to combine their crutches with his clothes and occasions of use. Practical tests were performed making use of these actuated crutches and it have shown in perfect working order, which according to the users who performed the tests, considerably reduces the force needed to lift.*

Keywords: *crutch, electronic, biomechanics*

1. INTRODUCTION

Devices created to assist in mobility are often used by people with disabilities in the lower limbs. Axillary crutch is perhaps the oldest design for this function. Sees its presence in designs that are from ancient Egypt, around 2830 BC, Fig. (1). They suffered few modifications and innovations in recent years and therefore are not being heavily used. This type of crutch has one of the lowest energy costs when compared to other types of crutches, canes and walkers "LeBlanc et al, (1993)", and have the advantage of releasing the hands of users when stopped, to open or close doors and other movements with his hands causing greater freedom and wellbeing. However, in general the use of crutches user increases the energy expenditure compared with the normal gait "Michael and Livine, (1999)".

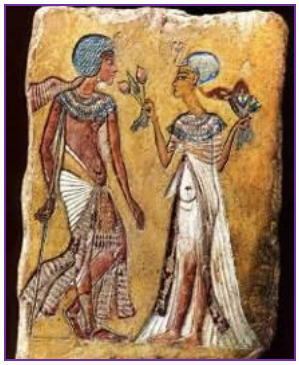

Figure 1. Echnaton suns with crutches 1350 B.C (Egypt museum, Berlim)

In addition to these damages, a major problem in the use of crutches in general and in particular the axillary is the difficulty generated to the user to sit and stand up and also going up and down stairs, increasing their dependence and causing embarrassment.

2. OBJECTIVES

Based on the problems in the use of axillary crutches, this research intended to solve or reduce the damage caused by them. Therefore, it focuses on increasing vertical mobility of the axillary crutch user, and make it a more personal and customizable, with a modern look. The idea is that the axillary crutch be an individual extension, bringing practicality to the user.

3. METODOLOGY

In order to improve the vertical mobility of the axillary crutch, allowing that it can change its course quickly and help the user sitting and standing and even climbing stairs, have been adapted electronic linear actuators able to retract and extend the crutch according to the user's needs. The used actuators can support up to 60 kilograms each in a range of 18 feet, also, the actuators can operate in a speed of 1 in/s. To ensure perfect assembly of the prototype with all its components, a 3D model was created using Solidworks program considering every detail of the model. Fig. (2) shows the CAD drawing of the crutch and actuator.

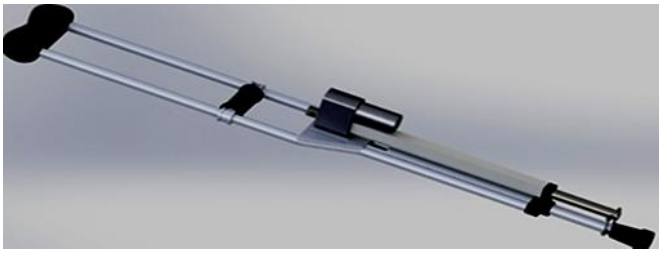

Figure 2. Crutch with the linear actuator

To enable control the course and position of crutches an Arduino UNO microcontroller are used in each one. Its activation is made by two buttons located below the right crutch handle, as shown in Fig. (3). Green button rise the crutch and red retract it. Communication between the two crutches is done via radio frequency and enables it to be in the same position, avoiding problems in the shoulder joints. To ensure the autonomy of electronics, lithium batteries are used, which are capable of supporting the entire system for 30 hours. Also a connection via Bluetooth was created with smartphones with Android platform, this connection enables the user to monitor the levels of the batteries and calibrate them if you notice a slight difference in position. For this, an application for android platform was created. Another important function of the application is the calibration of limit of the crutches according to the user's height, which is reported to the application in the first use, data re-entry is permitted if the other person to use the device. Thinking about the aesthetics and comfort of the user, the apparatus is customizable creating the idea of a fashionable tool. To hide the actuator, electronics and battery was created a case, attributed the crutch harmonic and modern forms, Fig (4).

Figure 3. CAD model with all components

Figure 4. Crutch prototype

The case was built using the vacuum forming method, being resistant and inexpensive, allowing the user to change their cases according to his occasion of use. Fig. (5) shows three examples of customization.

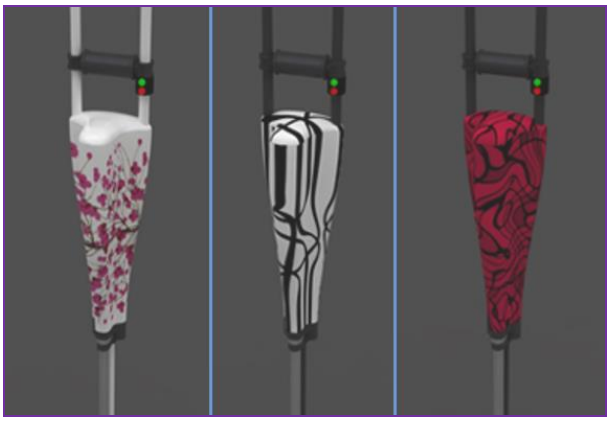

Figure 5. Samples of customization

4. RESULTS

To test the improvement in vertical mobility of the crutch, practical tests were done in users. The tests showed that the system helps the patient lift and retract his body reducing the effort required for these actions, Fig. (6).

Figure 6. User testing vertical mobility

5. CONCLUSION

After the tests, we observed a great improvement in vertical crutch mobility, which is capable of lifting up to 100% of the weight of the user, making its performance more independent and taking the idea of only one crutch as medical equipment, it has transformed it in a prop.

6. REFERENCES

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8. RESPONSIBILITY NOTICE

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