Therawalk: A Therapeutic Walking Assistant

Team 10

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Abstract — The orthotic device to be designed, currently named the "Therawalk", is a therapeutic walking assistant. The goal of the project is to create a versatile orthotic device that will aid patients in mobility and provide relief for ailments such as arthritis. Therawalk will incorporate thermotherapy and vibrational components to help alleviate the pain caused by arthritis. This will benefit patients who need the aid of a cane, but find the use of one difficult due to the pain in their hands or who struggle with maintaining grip on the cane handle.

Development of the Therawalk will focus primarily on the integration of electrical components such as the vibration motors and heart rate sensor to a mechanical cane design. Additionally, the cane design will be revisited to enhance aesthetic characteristics, and ensure optimal integration of all the cane's functionality, as well as leaving room for future improvements. The goal of this project is to produce a smart orthotic device that will help the patient's mobility in both clinical and home settings. The Therawalk will have components to deliver thermotherapy and vibrational therapy, as well as additional electrical components such as a flashlight and heart rate sensor.

Keywords - ***Smart Cane, Thermotherapy, Vibrational Therapy, Osteoarthritis, Sensors***

I. Introduction

To understand the importance of how crucial a walking aid is in today's society one must realize the benefits and demands of using one. These mechanical aids provide balance support and assist in the daily activities of elderly, stroke patients, and pain from injury or clinical pathology such as hip fracture and arthritis. More than 4 million people use canes globally and more than 1.5 million use walkers in the United States alone [1].

Canes and walkers have had direct benefits to the physical and emotional wellbeing of its benefactors. They provide confidence and set users at ease making them more independent in their day to day lives. This allows them to be less sedentary that prevents osteoporosis of bone mineral, enhances circulation, and reduces cardiorespiratory deconditioning [1]. A study on 24 elderly patients, in which 12 used walking aids while the other 12 initially did not, proved through surveys that walking aids enabled continued participation and provided health benefits of well-being [3]. Many of the 12 decided to walking assistants after being informed of the benefits for the aging human body. With the onset of arthritis and generalized weakness using a support is crucial when it comes to balance control and improving quality of life through promoting independence.

The biomechanical support and neuromotor benefits are what make a cane useful. To achieve static postural equilibrium where there is no net force action on the body the body's center of mass (COM) must be placed directly over the base of support (BOS). The use of a cane or walker increases the range of the BOS, which results in a larger area of support for the COM to stay centered. A walking aid also can shift the brute force of the cyclic load onto the more stable limb [1]. In this way, the body is balanced and the risk of falling over is minimized.

II. Methods

The components of "Therawalk" include the vibrational and thermal inserts, sensors, power supply, and a flashlight. The Therawalk components such as a thermal and vibrational inserts help alleviate pain and discomfort. The vibrational insert helps stimulate blood from the OA hand, the blood flow brings warmth to the area that is inflamed. The thermal component reduce pain and discomfort from the OA hand. The sensors detect and relay heart rate

of a patient, the data will be outputted from the pulse sensor to an LCD monitor. The cane will enhance the ability of physical therapists to monitor their patients progress by installing wireless communication via Bluetooth and Arduino. The progress of the patient would not only be monitored in a clinical setting, but on the outside; This enables the therapists to interact with their patients in a timely basis regardless of time or physical location [2].

In the design of the "Therawalk", it is important to also consider the handle design in terms of comfort and effectiveness for the patient. A study found that changing the shape of the handle impacts patient gait and cane loading [4]. To optimize the patient's comfort and increase ease of use of the device, a hollow base was chosen. The hollow base allows the patient to lean on the cane while reducing the weight of the cane.. All of the electrical components of the cane will be placed inside of the cane's handle and base.. The sensors will be connected to an LCD monitor in order to output the patient's heart rate, while simultaneously relaying the information via Bluetooth to a computer or smartphone. The thermal and vibrational inserts will be placed on the top of the base where the patient will hold the cane. The flashlight will help improve patient visibility while in the dark.The rechargeable battery provides power to these components. Having a rechargeable battery is environmentally friendly and efficient as the patient will not have to constantly replace the battery, and instead just recharge the cane battery as needed.

III. Results/Discussion

The electronic equipment was placed parallel to and powered by 7.4 V LiPol battery supply. The heating pad purchased from Adafruit (Product ID: 1481) consumes the battery supply within five minutes of continuous use necessitating a more practical thermal insert for regular operation of Therwalk. The flashlight was a 'Cool' white LED purchased from Adafruit (Product ID: 518) that ran up to 1 hour with continuous use. The current design of Therawalk uses the PulseSensor by World Famous Electronics LLC and outputs data with Arduino UNO. Figure. 1 was displayed on serial plotter and serial monitor after successful installation and connection of the heart-rate sensor to the current mechanical design of Therawalk.

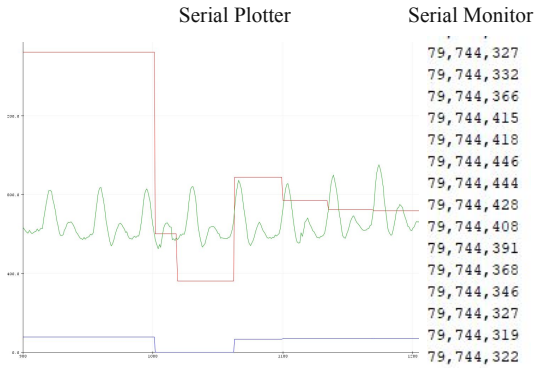

Figure 1. *The abscissa represents time in milliseconds. The ordinate on the left is the plot of BPM, beats per minute (blue), IBI, interbeat interval in milliseconds (red), and pulse wave data in milliVolts (green) on serial plotter. On the right is the BPM, IBI and pulse wave data displayed from left to right on the serial monitor.*

IV. Conclusion

The goal of this project is to produce a smart orthotic device that will help the patient's mobility in both clinical and home settings. The Therawalk will have components to deliver thermotherapy and vibrational therapy, as well as additional electrical components such as a flashlight and heart rate sensor. Additionally, the cane design will be revisited to enhance aesthetic characteristics, and ensure optimal integration of all the cane's functionality, as well as leaving room for improvements in future iterations of the cane's design.

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