

MOBILE APP-CONTROLLED MOTORIZED WALKER FOR PARKINSON'S DISEASE: A REVISED PROPOSED DESIGN

Sergio Sarza Jr., PT, DPT, DRDM^{a,b,c,*}; Lilianna Dela Cruz, PT, BSc,^{a,c}; Nelaine Dela Cerna, PT, BSc,^{a,c}; Aurea Ranises, PT, BSc,^{a,c}; Winston JonCraig Lee, PT, BSc^{a,c}; Winston Joses Lee RME^d; Matthew Dela Cruz, RME^e

ABSTRACT

Introduction: Parkinson's disease could lead to the development of a festinating gait pattern characterized by a progressive increase of speed. This study aimed to develop a mobile application that could be used to remotely control the movement and speed of a motorized walker. The researchers were able to develop a mobile application with simple command buttons that could be used to remotely control a motorized walker with external cue devices.

Methods: This study utilized the developmental method of research. With the assistance of an engineer, the researchers created a mobile application that could remotely control a motorized walker using an Arduino software program and a Bluetooth HC-03 module. The mobile application was designed at a private non-commercial facility in Cebu City. There were no respondents for this research.

Results: The researchers were able to develop a mobile application with simple command buttons that could be used to remotely control a motorized walker with external cue devices.

Conclusion: The mobile application was not tested by experts nor by actual patients. This study will serve as a groundwork for further research on assistive devices for patients with Parkinson's disease.

KeyWords

Gait rehabilitation, mobile app-controlled walker, motorized walker, Parkinson's disease physical therapy, remote control walker, smart walker

INTRODUCTION

Parkinson's disease (PD) is a chronic progressive disease of the central nervous system [1]. According to Prizer & Browner, it is second to Alzheimer's disease among the most common neurodegenerative disorders [2]. Motor and nonmotor symptoms characterize the disease. The classic features include resting tremor, rigidity, postural instability, and bradykinesia [3].

The most common disabling symptoms of Parkinson's disease are its associated gait impairments [4]. Among the elderly population, the major cause of morbidity is gait disorder [5]. These gait disorders are the leading causes of falls in Parkinson's disease [6].

Impoverished movement results to a number of significant gait changes [7]. An abnormally stooped posture could lead to the development of a festinating gait pattern which is characterized by a progressive increase in speed accompanied with a shortening of stride [7]. Festinating gait is also known as Parkinsonian Gait. It is distinguished by speedy and small steps which are made in an effort to keep the center of gravity in between the feet while there is an involuntary forward leaning of the trunk [8].

Another type of abnormal gait pattern that is common among patients with Parkinson's Disease is the Freezing of Gait (FOG). This is one of the major debilitating motor symptoms of PD that has a great impact on daily living. This is also one of the main causes of falling and in consequence, the risk of fractures is increased [9]. As the disease progresses, the prevalence of FOG also increases [10].

Patients who are at high risk of falls must immediately be referred for rehabilitation in the earliest time possible because medications for Parkinson's Disease and surgeries could not really improve gait [6]. Symptoms such as gait alterations and postural instability respond poorly to pharmacologic therapy [11].

In a study made by Earhart et al., there is a key issue in Parkinson's Disease as most patients are only referred for rehab and a decrease in mobility. Because of this, the rehabilitation care provided is already in a tertiary prevention model of care when secondary preventive care could have been provided. Ideally, early PD signs and symptoms should be addressed immediately upon diagnosis so that function could be maximized and progression of the disability could be slowed [12].

As the symptoms in PD progresses, there is already a need to prescribe assistive devices [13]. Mobility aids such as walkers and canes help patients be a lot more dependent with their everyday activities. For the past years, various researches have already been made to examine the effectiveness of these mobility aids in mitigating the symptoms of Parkinson's disease and it did have a positive result. Studies adding modifications to mobility aids in order to improve its quality and effectiveness have also been done.

This study is a continuation of a study by Lee [14] entitled "Motorized Walker with External Cue Devices for Parkinson's Disease: A Proposed Design." This study will focus on introducing a new technology that will allow the motorized walker to be controlled using a mobile application through Bluetooth. This feature would allow the movement and speed of the motorized walker to be controlled remotely. This reduces the efforts of therapists and increases the safety of patients during gait training.

Many people would benefit from this study. Aside from therapists and Parkinson's disease patients, families and caregivers of these patients would also greatly benefit from this study because it would allow them to have control over the direction and speed of the motorized walker. Thereby, increasing sense of security while promoting normal cadence during gait training. So it could be assured that the patient is ambulating according to his level and capacity.

METHODS

Research Duration

This study was conducted in four months starting from December 2019 until March 2020. Within this four-month period, all steps to be undertaken are done, which includes the designing of an interface circuit for the Bluetooth module to the Arduino microcontroller, as well as the building and testing of the Arduino software and the mobile application.

Research Design

This study utilized the developmental method of research which is a systematic study of designing, developing processes and products that must meet the criteria of internal consistency and effectiveness.

Site of the Study and Available Facilities

The mobile application was designed at a private non-commercial facility in Cebu City.

Materials and Equipment

This study utilized a prototype of a motorized walker. The frame of the device is made up of aluminum with plastic caster type of wheels and rubberized outer surface attached proximally to the base.

The HC-05 Bluetooth module served as the point of connection between the Arduino Nano microcontroller and a bluetooth-enabled Android mobile device. The commands for motor speed control are transmitted and received serially to the Arduino through the transmit (TX) and receive (RX) pins. These commands are then interpreted by the microcontroller to start, stop, and vary the speed of the motor.

Conclusion

This study aimed to add a new feature to the prototype of a motorized walker with external cue devices from the study of Lee [14]. A mobile application was developed to allow the movement and speed of the motorized walker to be controlled remotely through Bluetooth. By following a five-step process, the researcher was able to develop a mobile application that serves as a remote control to the motorized walker. This study will serve as a groundwork for further research about technological innovations on assistive devices for patients with Parkinson's disease. Lastly, this study will favor Parkinson's disease patients, their families and caregivers, and the rehabilitation community as well.

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Figures

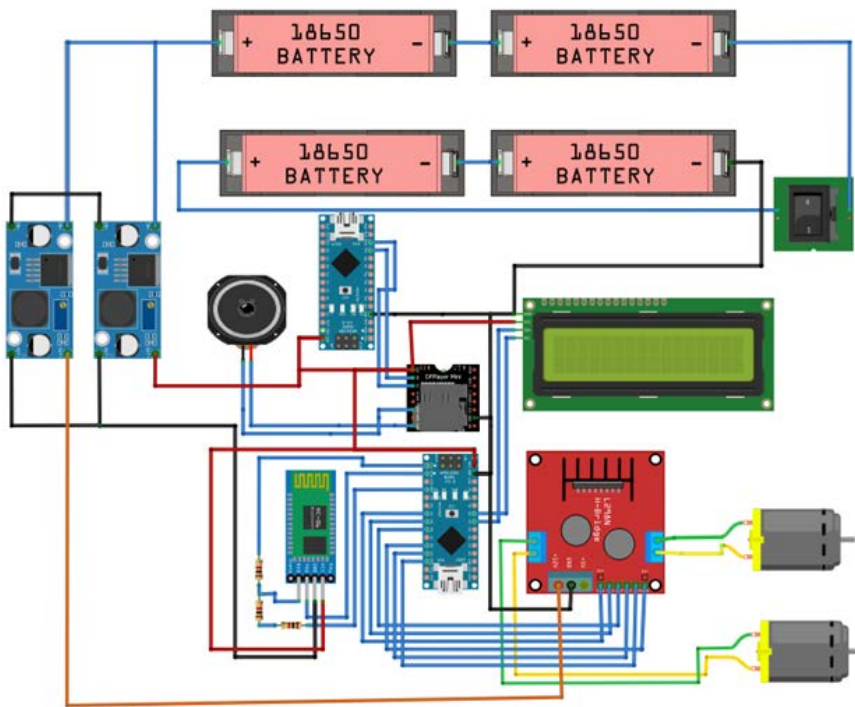


Figure 1. Wiring Diagram

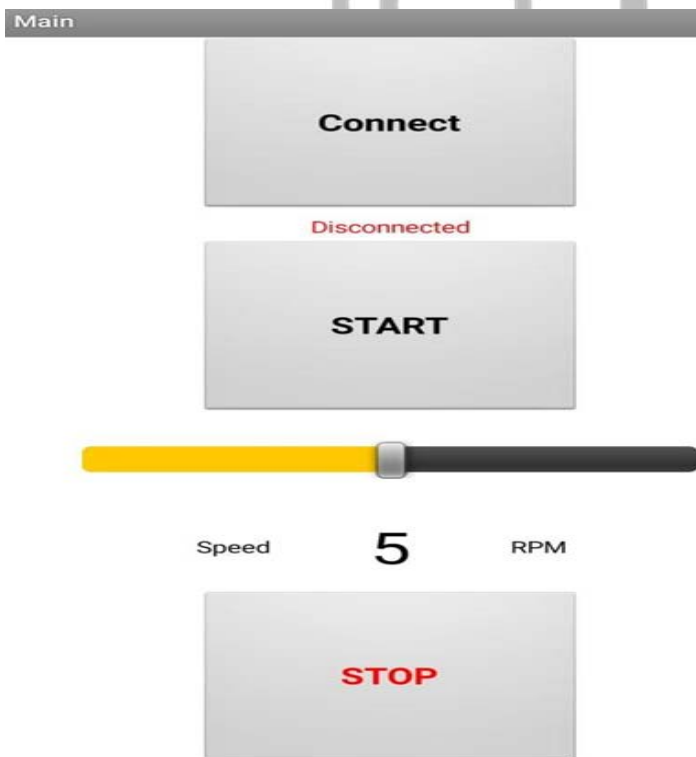


Figure 2. Mobile Application Design