Haptic Robot Assisted Neurorehabilitation

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Abstract— Several studies have been conducted to test the feasibility and effectiveness of using a combination of virtual reality and haptic feedback from robotic systems to aid in the recovery of patients suffering from post stroke and hemiplegic cerebral palsy upper extremity impairments.

I. INTRODUCTION

THERE are an estimated seven million people in the United States who have survived a stroke, with only 10% recovering completely. The national stroke association estimates that 40% of patients surviving strokes suffer moderate to severe impairments requiring special care. In addition, the CDC reports that 1 in 303 children in the United States are born with cerebral palsy (CP), with one third of these children experiencing hemiplegia. Both of these conditions have a high probability of leaving the patient with upper extremity impairments. It is hypothesized that the combination of complex 3-D virtual reality programs and advanced robotics can assist these patients by speeding up the neurorehabilitation.

II. METHODS:

Studies conducted thus far involve the use of a robotic device that is capable of both manipulating virtual objects and providing haptic feedback to the user. The second aspect of this rehabilitation method is a virtual reality program in which the user can complete a variety of tasks to improve joint and muscle function. Some of these devices, such as the Haptic Master, are capable of using assistive technology, which assists the patient in making the required movements if they are not yet able to make them independently.

III. RESULTS

In two studies conducted by Sergei Adamovich the effectiveness of the Haptic Master system was tested in small groups of children suffering from hemiplegia alongside cerebral palsy, and a separate study of adults with upper extremity impairments following a stroke. In both studies the effectiveness of the robotic assisted therapy was measured by the time taken to complete a given task and the smoothness of the arm movements. With the stroke patients, all participants showed a decrease in the time needed to complete the task; the percent change in duration was 57%, 49%, 36%, and 26% respectively. The improvement in the smoothness of movements in all four subjects was 91%, 84%, 32%, and 72% respectively. The study with children suffering from CP shared similar results; the exact data can be seen in figures 1 and 2. Based on the data gathered from both studies it is clear that the robotic assisted therapy had a positive affect on patients arm movements in both test groups.

IV. DISCUSSION

While it can be safely hypothesized that robotic assisted therapy is a viable form of neurorehabilitation in patients suffering from cerebral palsy or post stroke impairments there is not yet enough clinical data to prove this true or false. There are also several drawbacks with this method of treatment. Firstly, to be eligible for therapy patients must have enough control of their extremities for the robot to recognize their movements. This type of therapy can also be quite costly. While pricing for the Haptic Master could not be found, a similar system created by Cyber Glove Systems retails for nearly $200,000.

Despite these drawbacks this type of therapy has the potential to have greater benefits. With particular respect to children, this type of therapy adds an aspect of enjoyment, making the recovery process almost like a video game. The major technical advantage to this type of treatment is the assistive technologies. The Haptic Master and other similar devices have the ability to guide the patient through the movements before they are able to execute them independently. This type of repetitive movement could prove to be the key in providing neurorehabilitation to patients suffering from upper extremity impairments.

REFERENCES


