The effects of using a modified motorcycle simulator training for the spinal cord injury patients

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ABSTRACT

This is a first step study to investigate the effects of the training with virtual reality (VR) system in different situations for Spinal cord injuries (SCI) patients and evaluate the riding performance and the balance ability of patients with SCI to deal with different road conditions. And is also a very early stage study to investigate whether the training effects can transferred to the real road. SCI patients increase by 1200 people/ year in Taiwan. Some studies found that SCI patients who have jobs and transportation had more positive self-concept. Modified motorcycles are the most popular transportation tools used by SCI patients in Taiwan. The purpose of this study is to investigate the training effects of a motorcycle riding training program with modified motorcycle virtual reality simulator (MCVRA) for the spinal cord injury patients. In this study, five SCI subjects were included in this study. They received ten 30-minutes training sections in one month, and the riding performance, balance ability and questionnaires were measured before and after 5 and 10 training sections to evaluate the program effects. However, only three subjects completed 10 training sections due to discharge or being transferred. Results revealed that the riding performance and balance ability under VR environment and on road test were improved after the MCVRA. The subject's enjoyment, confidence and motivation of motorcycle riding also increased dramatically after the MCVRA. No cyber-sickness or other side-effects was noted during the training program. We found that the riding performance and balance ability would be improved after VR training and the training effects seem able to be transferred to the real world road. Trained and assessed with MCVRA designed for SCI should be feasible and useful.

KEYWORDS: Virtual reality, spinal cord injury, physical therapy, modified motorcycle.

1   INTRODUCTION

Spinal cord injuries usually damage to the central or peripheral nervous systems that cause problems of sensory and motor functions. The key functional deficit of SCI is poor balance and it usually makes the patients' performance of activities of daily living decrease and influences their quality of life [1]. VR is a new high technology developed in recent years and has been used in many fields, such as aviation, military, or medical field. Now it also has been attention on rehabilitation because training with VR has many advantages, such as more safety, interesting, users have less discouragement, and low cost [1-2]. Although there are many studies about the simulator designing and development, there is no research documenting the applications on rehabilitation. There were also only very few studies related to the connection of training effects between the VR environment and the real world. We will investigate those topics in this study by analyzing the performance of riding and balance ability in MCVRA and the real world.

2   EXPERIMENT EQUIPMENT

The MCVRA, showed in Fig.1, was designed for both assessment and for training. All the scenarios were designed as urban and followed the transportation laws. One of the scenarios was designed as the assessment route for evaluating subjects in the real world to compare the performance.
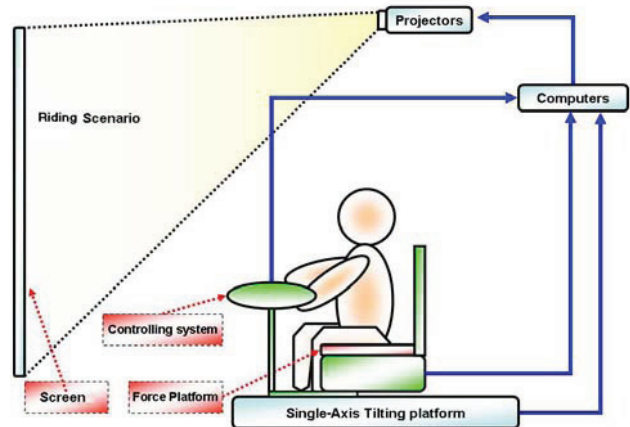

Figure 1. Modified motorcycle virtual reality simulator system

3   RESULTS AND CONCLUSION

Although the VR systems can't 100% simulate the real world, it could induce similar human body reaction and movements. It means we may assessment and training by a safer way with a less impact to participants in VR. There is a potential of VR for some patients who need assessment and training but have higher risk. Through the VR system, we can get many detail objective and precise data which hardly to get from the real world to evaluate the performance. Moreover, the same results of improvement tendency on riding performance and balance ability performance were found in the VR system and in the real world. That reveals the training effects can be transferred to the real world. Therefore, it seems using MCVRA to do assessment and training riding modified motorcycle and balance ability is feasible. Because the relative researches are still limited, more studies are needed.

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