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Encouraging overweight students with intellectual disability to actively perform walking activity using an air mouse combined with preferred stimulation

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ABSTRACT

This study continues the research on using an air mouse as a physical activity detector. An air mouse is embedded with a MEMS (Micro Electro Mechanical Systems) gyro sensor, which can measure even the slightest movement in the air. The air mouse was strapped to one of each participant's calves to detect walking activity. This study was conducted to evaluate whether four students with intellectual disability who were overweight and disliked exercising could be motivated to engage in walking actively by linking the target response with preferred stimulation. Single-subject research with ABAB design was adopted in this study. The experimental data showed substantial increases in the participants' target responses (i.e. the performance of the activity of walking) during the intervention phases compared to the baseline phases. The practical and developmental implications of the findings are discussed.

What this paper adds?

An air mouse is embedded with a MEMS (Micro Electro Mechanical Systems) gyro sensor, which can measure even the slightest movement in the air. With the application of software technology, the default function of an air mouse can be extended and the air mouse can be used as a walking activity detector. In this study, the air mouse was strapped to one of each participant's calves to detect walking activity. In addition, this study employed the participants' preferred stimulation to increase their motivation to perform walking activity. The findings of this study demonstrate an air mouse combined with the preferred stimulation is an effective intervention to increase the duration of walking activity for four students with intellectual disability.

1. Introduction

With the advancement of technology, many high-tech products are cheaper, more accessible, and possess more powerful functions than ever. Some of these high-tech products contain sophisticated sensors or detectors which can detect specific physical behaviors. For example, a computer mouse can detect the precise movement of a hand on the desk; a mouse scroll

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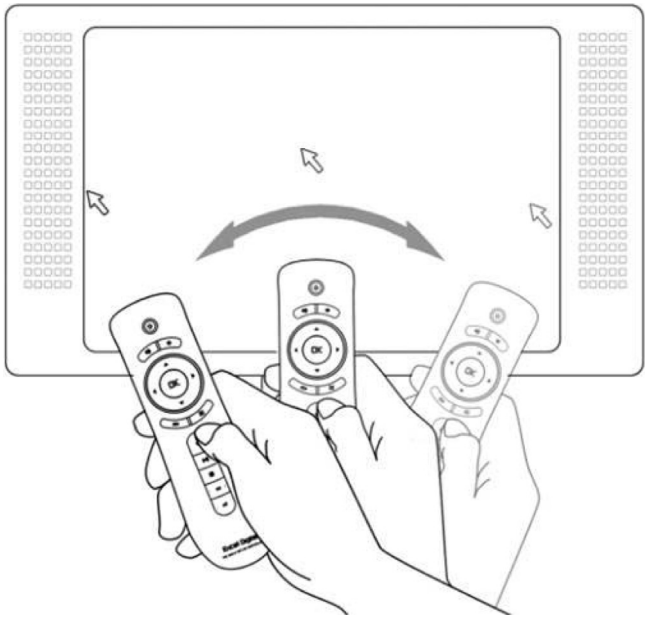

Fig. 1. A gyration air mouse embedded with a MEMS (Micro Electro Mechanical Systems) gyro sensor is able to detect any slight movement in the air (Gyration, 2014).

wheel or trackball is able to detect thumb/finger pokes; an air mouse or Nintendo Wii Remote Controller can detect limb action/movements, and a Nintendo Wii Balance Board can detect standing posture and center of pressure.

Turning these high-tech products embedded with sophisticated sensors or detectors into assistive technology (AT) devices is a feasible solution to meet the needs of people with disabilities (Shih, 2011, 2013a, 2013b; Shih, Chang, & Shih, 2010a; Shih, Chang, Wang, & Tseng, 2014). This solution can provide additional choices for people with disabilities when it comes to using AT devices, and offers them the opportunity to use very common, cheap and powerful high-tech products instead of specialized AT devices.

Recently, some studies have developed techniques to modify the software to reset the functions of high-tech products and turn them into powerful AT devices to meet the special needs of people with disabilities. Using these methods, researchers have used these products to detect individuals' simple behavioral actions combined with preferred stimulation for (a) rewarding or motivating specific target behaviors, such as performance of simple occupational activities (Chang & Shih, 2014; Shih & Chang, 2012; Shih, 2013b; Shih, Chang, & Mohua, 2012) or simple physical activities (Shih, Chen, & Shih, 2012; Shih & Chiu, 2014; Shih, Chung, Shih, & Chen, 2011; Shih, Shih, & Luo, 2013); and (b) reducing the frequency of unwanted or improper behaviors, such as rectifying abnormal standing posture (Shih, Shih, & Chu, 2010) and head posture (Shih, Shih, & Shih, 2011), or reducing limb hyperactive behavior (Shih, 2011; Shih, Yeh, Shih, & Chang, 2011).

The wireless gyration air mouse is a hand-held commercial computer pointing device with an embedded MEMS (Micro Electro Mechanical Systems) gyro sensor, as shown in Fig. 1 (Gyration, 2014). It is able to detect the user's motions and convert the movements into operations for the computer mouse cursor. Since air mice are designed to be wireless, the wireless transmission function enables users to operate the computer flexibly and with no limitations, by performing motions in the air (Gyration, 2014; Logitech, 2014).

An air mouse is capable of detecting its own movement and utilizes the function of wireless transmission, so it can be applied to fields beyond what it was originally designed for. However, this is not an easy task, due to the fact that air mice available on the market are specifically designed to operate as standard input devices for computers. Once air mice are connected with computers, the latter will automatically recognize them as standard mouse devices and will install the appropriate mouse drivers. Thus, the usage of air mice is quite restricted, and it is difficult to apply them for other purposes. Nonetheless, with the assistance of software techniques, the scope of applications of air mice can be extended (Shih, 2011; Shih, Chang, & Shih, 2010b; Shih et al., 2013) and these tools can be applied to other fields without changing the original hardware or the devices' appearance. For instance, by substituting a redesigned mouse driver for the built-in mouse driver, an air mouse can be used in special education and habilitation as an assistive technology device to help people with disabilities to suppress undesirable behaviors (Shih, 2011) or to encourage positive behaviors (Shih et al., 2010b, 2013).

Shih et al. (2013) experimented with two participants with intellectual disability (ID) to examine the efficacy of applying an air mouse to detect their physical activity, and participants' perferred stimulation was used to increase their motivation to perform activity. The study presented preliminary findings and the outcome was positive. The experimental purpose was to encourage the participants to perform physical activity generally, in that there was no assigned specific motion. Hence, the air mouse was put in the participants' pockets in order to detect their physcial activity.