Research in Developmental Disabilities 33 (2012) 2013–2019

Contents lists available at SciVerse ScienceDirect

Research in Developmental Disabilities

Enabling people with developmental disabilities to actively follow simple instructions and perform designated occupational activities according to simple instructions with Battery-free wireless mice by controlling environmental stimulation

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ARTICLE INFO

Article history:
Received 29 November 2011
Received in revised form 22 May 2012
Accepted 22 May 2012
Available online 28 June 2012

Keywords:
Battery-free wireless mouse
EOLDP
Occupational activities
Developmental disabilities

ABSTRACT

This study extended Battery-free wireless mouse functionality to assess whether two people with developmental disabilities would be able to actively perform designated simple occupational activities according to simple instructions by controlling their favorite environmental stimulation using Battery-free wireless mice with a newly developed extended object location detection program (EOLDP). This study was performed according to an ABAB sequence in which A represented the baseline and B represented intervention phases. Data showed that both participants significantly increased their target responses (performing a designated occupational activity) by activating the control system to produce their preferred environmental stimulation during the intervention phases. Practical and developmental implications of the findings are discussed.

Occupational activities (such as putting objects in the correct position, rotating objects from one side to another side, and taking objects out of containers) are important elements that help people with disabilities, elderly people or patients to achieve functional outcomes which improve fine or gross motor skills, promote health and prevent injury or disability. Through the use of purposeful activities, or designed interventions, individuals can develop, improve, sustain or restore the highest possible level of independence, increase their self-esteem, become functioning productive members of society, and achieve a fulfilled and satisfied state in life.

Recent research has demonstrated that using commercial high-technology products with special embedded sensors or detectors in combination with assistive software technology suitable for detecting participants' simple limb (e.g. hand) activities, along with the rewarding of desirable behaviors, enables people with disabilities to actively perform simple occupational activities (such as putting objects in the correct locations or rotating specific objects from one side to another) and improves their levels of response and environmental stimulation control (Shih, 2011b; Shih & Chang, 2012; Shih, Chang, & Mohua, 2012; Shih, Wang, Chang, & Shih, 2012). For example, (a) using Battery-free wireless mice (embedded Radio Frequency Identification – RFID sensor) (A4Tech, 2010) with a newly developed object location detection program (OLDP) to help two people with developmental disabilities to actively perform simple occupational activities (moving a specific object from one destination to another destination) by controlling their favorite environmental stimulation (Shih, 2011b) and

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0891-4222/$ – see front matter
http://dx.doi.org/10.1016/j.ridd.2012.05.021

(b) using a Wii Remote Controller (embedded three-axis accelerometer sensor) (Nintendo, 2010; Wikipedia, 2009c) with a newly developed three-dimensional object orientation detection program (TDOODP) to assess whether two people with developmental disabilities would be able to actively perform simple occupational activities (taking a specific object, rotating it from one side to another side and then putting it down) by controlling their favorite stimulation (Shih, Chang, et al., 2012; Shih, Wang, et al., 2012).

The above mentioned studies focus on adopting software technology to reset the functions of standard commercial products (i.e. Battery-free wireless mouse and Wii Remote Controller), thereby turning them into much more useful assistive technology devices that allow people with disabilities to obtain rewards for desirable behaviors and actively perform simple occupational activities, providing them with additional choices in assistive technology. The results have generally been encouraging.

The Battery-free wireless mouse (A4Tech, 2010) is a wireless mouse, as shown in Fig. 1. Unlike any other wireless mice, it does not require batteries. It comprises: (a) a Radio Frequency Identification (RFID) mouse pad and (b) its partner – a wireless mouse. The RFID mouse pad is connected to the computer's USB port. It generates an electric field around the pad to transfer necessary power to the wireless mouse wirelessly through electromagnetic induction – RFID technology (RFID.org, 2010; Wikipedia, 2009a). The RFID mouse pad receives the wireless mouse operation signal via wireless connection to the computer. By simply placing the wireless mouse on the RFID mouse pad, the wireless mouse draws instant and constant power from the RFID mouse pad and works like a standard wireless mouse. Therefore it does not need batteries to keep it powered up (i.e. battery-free operation).

Based on its electromagnetic induction technology, when combined with matching assistive software programs, the RFID mouse pad can be used as a high performance object location detector to detect the location of its partner, the wireless mouse. When the wireless mouse is placed on the RFID mouse pad, it works like a standard wireless mouse, but this default function can be extended to cover many other applications, such as allowing users to obtain desired environmental stimulation through actively performing simple occupational activities, for example, putting objects in the correct location.

The Battery-free wireless mouse is a standard mouse device for computers. Once it is connected to a computer, the Windows operating system (OS) will identify this device and install its driver (i.e. standard mouse driver) automatically. The computer will then define its function as a moving cursor, which can be clicked and dragged. Therefore, it is not easy to change the Battery-free wireless mouse function to adapt it for other applications, especially for those designed to assist people with disabilities.

Shih (2011b) developed a new software program – the object location detection program (OLDP), which can be used to change a Battery-free wireless mouse's default function, turning it into an object location detector. Shih assessed whether two people with developmental disabilities would be able to actively perform simple occupational activities by controlling their favorite environmental stimulation using two Battery-free wireless mice. The key technological feature of the OLDP is the redesigned mouse driver that can intercept mouse action and distinguish which RFID mouse pad receives the wireless mouse operation signal. Redesigning the mouse driver allows for the resetting and changing of the mouse's functions, thus

Fig. 1. The Battery-free wireless mouse (A4Tech, 2010) does not need batteries to keep it powered up (i.e. battery-free operation). It comprises a Radio Frequency Identification (RFID) mouse pad and its partner – a wireless mouse. The RFID mouse pad transfers necessary power to the wireless mouse through electromagnetic induction – RFID technology (RFID.org, 2010; Wikipedia, 2009a), and receives the wireless mouse operation signal via wireless connection to the computer. Simply placing the wireless mouse on the RFID mouse pad allows the wireless mouse to receive instant and constant power from the RFID mouse pad and work like a standard wireless mouse.