

A platform for cognitive rehabilitation in Alzheimer's disease

A. LEONE, A. CAROPPO, P. SICILIANO. **A natural user-interface based platform for cognitive rehabilitation in Alzheimer's disease patients.** *Gerontechnology* 2014;13(2):244; doi: 10.4017/gt.2014.13.02.082.00

Purpose Although no cure is available, cognitive rehabilitation (CR) for patients with mild Alzheimer's disease (AD) appears to be an attractive treatment. In the last two years many technical solutions, such as serious games, have been studied for cognitive assistance^{2,3}. However, most of these initiatives (including commercial products such as Nintendo's Brain Age and Big Brain Academy) provide only memory challenges or random puzzles that are to be played a few minutes per day with the purpose of "improving brain performance". The objective of this work is the design and development of an Information and Communication Technology (ICT) platform that integrates advanced Natural User Interface (NUI) technologies for multi-domain cognitive rehabilitation (temporal and spatial orientation, visual and topographical memory, verbal memory and fluency, visual and hearing attention, etc.).

Method The platform architecture (Figure 1) is made up of a) a set-top-box connected to a TV monitor with internet connection, b) a commercial low-cost RGB-D camera (Microsoft Kinect), and c) an (optional) e-shirt (WWS Smartex) for monitoring vital signs. According to the specific rehabilitation program provided by the physician, the set-top-box automatically downloads customized sequences of exercises from a remote server, taking into account the patient's rehabilitation history and related factors. In order to make the system reliable, flexible, customized, and compliant with the international evaluation scales (MMSE: Mini Mental Scale Evaluation), few input parameters (amount of allowed errors and execution time, movement sensitivity) are set, and these parameters are based on the residual abilities of the patient. The system allows both autonomous execution of the required exercises and data reporting and storing of the daily performance for every exercise. In order to obtain more information during rehabilitation activities, the main vital signs (heart rate, breathing rate, electrocardiogram, etc.) are monitored if the subject wears the (optional) e-shirt. A Bluetooth radio link is used for transmitting clinical parameters to the set-top-box.

Results & Discussion The platform allows CR for AD patients without direct physician involvement in the rehabilitation session. (Performance metrics and clinical parameters are sent to the physician with a multi-modal paradigm for clinical evaluations.) For proper interaction with the system, measurements from the patient are acquired by the RGB-D sensor at a distance range between 80 cm and 400 cm, allowing Natural User Interaction through 100% hands detection rate (Figure 2). The system allows an audiovisual link with the medical center, so that the physician can interact with the AD patient during CR, increasing the compliance and efficacy of CR and ensuring that the type and intensity of treatment are appropriate.

References

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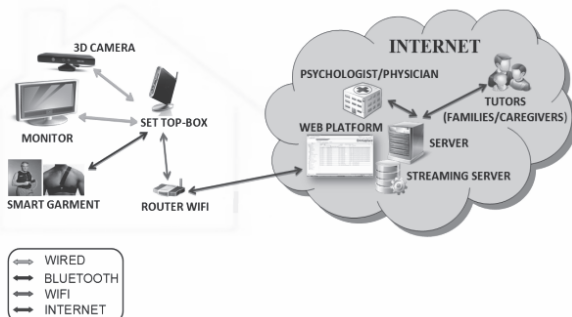


Figure 1. Overview of the NUI-based platform for cognitive rehabilitation



Figure 2. Rehabilitation approach by natural user interface