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Accessible Human Computer Interaction:
Video Games and Assisted Living for Persons with Severe Disabilities

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1. Introduction

Nowadays, being able to effectively use information technologies has a huge impact in the life quality of people with disabilities who depend on digital interfaces for communicating, learning and even having fun; and in the working conditions of the caregivers that support them daily. However, persons with severe disabilities still encounter many barriers through their lives when they want to access digital technologies or to benefit from them.

One of the challenges that these persons face occurs during childhood: children with severe motor disabilities cannot play *dynamic* video games because they lack the ability to use standard inputs (e.g. pads or mouse) and they often rely on one-switch interfaces, such as *scanning*, to interact with electronic devices. Although this kind of interaction works fine for writing and for general browsing and menu selection, it is not suitable for playing dynamic video games, which have game objects that can move around the screen and other complex visual scenes that change quickly at any time.

Another challenge faced by people with disabilities appears in their adulthood, while they live in assisted living facilities (ALFs): their caregivers need support systems to effectively monitor them, as well as to be alerted of potentially hazardous situations that may happen to the people under their care, but without sacrificing their independence and privacy. The problem is that currently there are not specific design guidelines for healthcare support systems directed to people with disabilities within assisted living facilities, but for systems intended to improve the quality of life of patients in their own houses, and how to support doctors and nurses within hospitals in the specific tasks their jobs entail.

2. Research Goal

This research aims at contributing to the improvement of the life quality of persons with severe disabilities, in two ways: first, by allowing them to play dynamic video games during their childhood, even with a single switch. Second, by eliciting a series of design guidelines for the creation of healthcare support systems to specifically improve the living conditions of disable adults in ALFs as well as the working conditions of their caregivers.

3. GNomon

GNomon [1] is a software framework that enables the creation of accessible and dynamic one-switch video games. In its basic operation, GNomon associates a small widget in the form of a clock face to each selectable game object on the screen. Each clock widget has a fixed clock hand at noon and another hand that rotates with the same speed for every clock, but with a different phase. To select an element, the player has to click the single switch, as precisely as possible, when the moving hand crosses noon. Then GNomon calculates for each clock the probability of being associated to the intended selection given the clicks thus far. When the probability of a clock reaches a predefined threshold, it turns green and its associated game object gets selected. Figure 1 shows an alien being selected in the GNomon-based game "One-Switch Invaders".
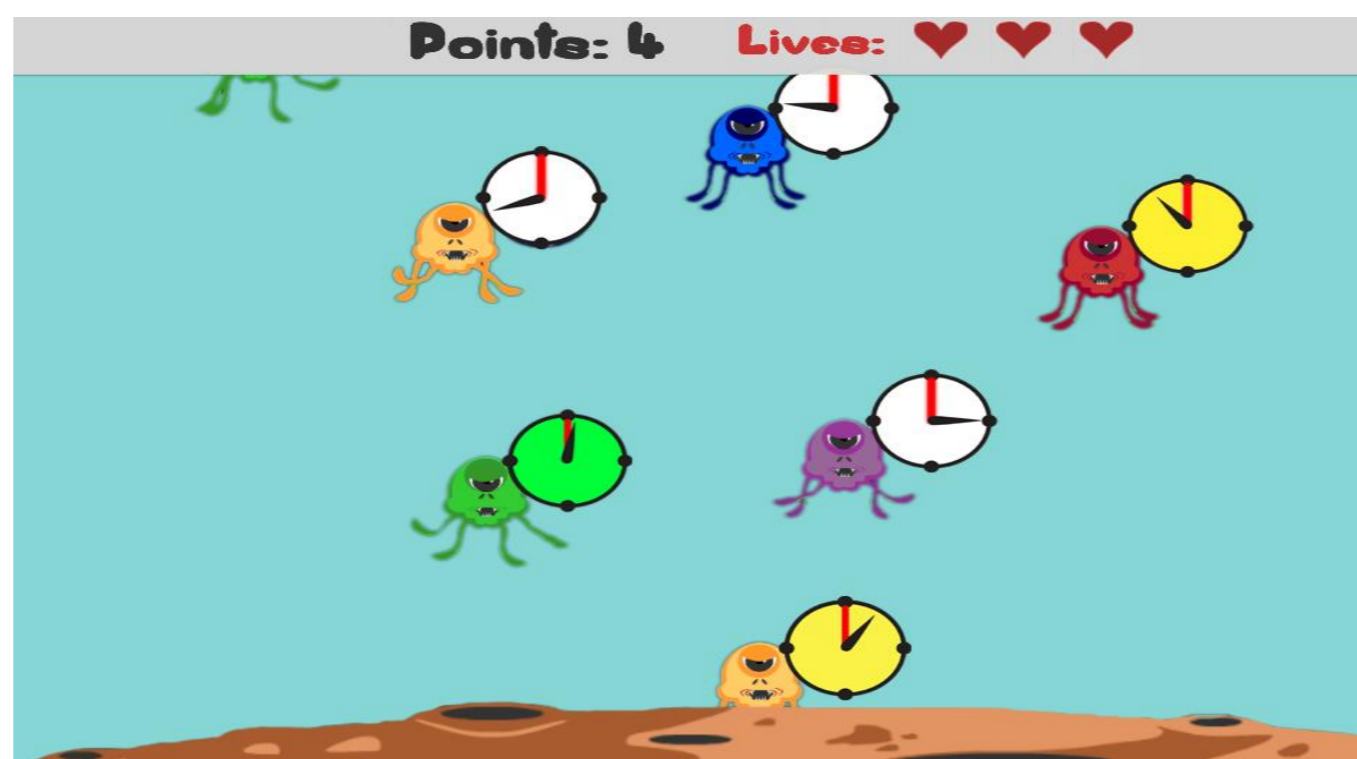

Figure 1: The dynamic GNomon-based video game One-Switch Invaders

The GNomon framework allowed to create 3 GNomon-based games that were used for evaluating the playability of GNomon-based games with a group of 8 children with severe motor disabilities in a multisession test. Other aspects of the games such as their rehabilitative suitability, the optimal selection widget and their multiplayer potential were also evaluated. Figure 2 illustrates a child in the middle of his test.
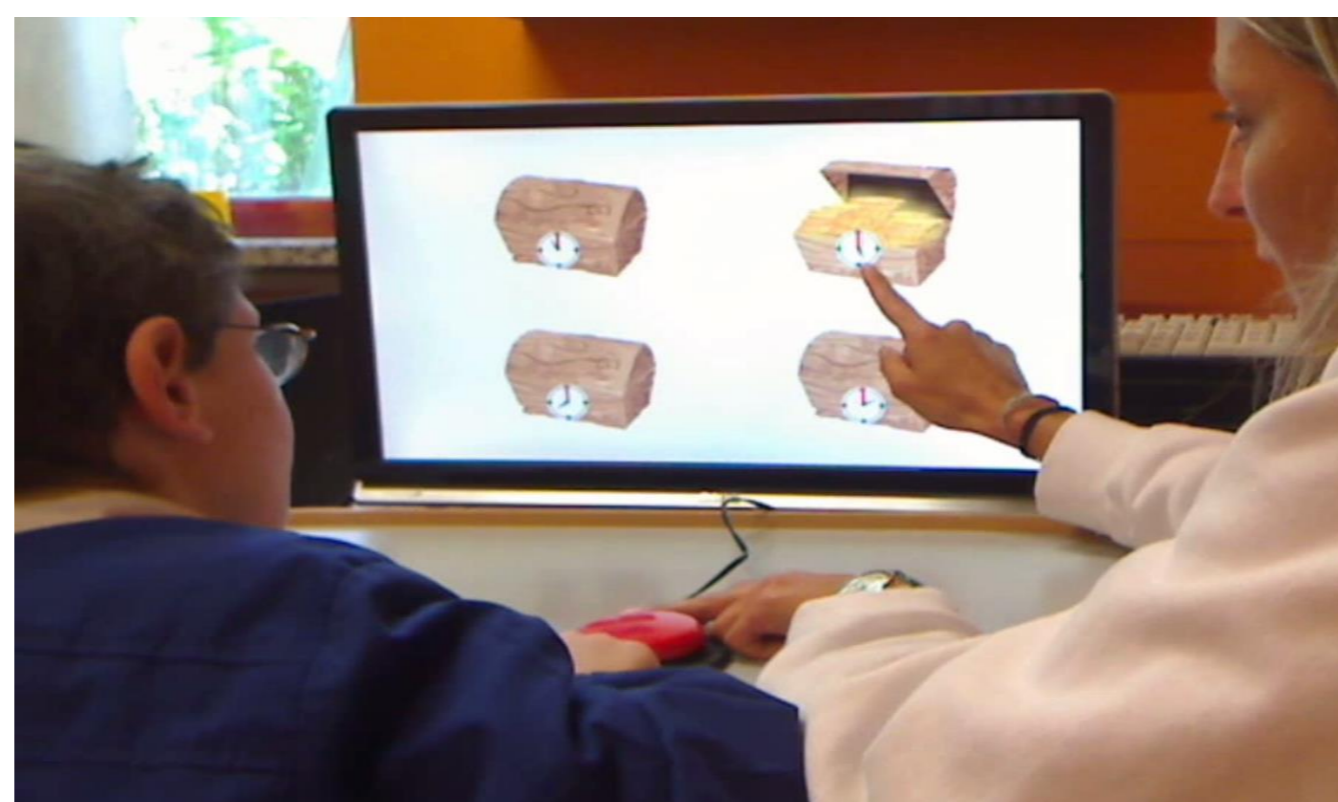

Figure 2: A child with disabilities playing the GNomon-based video game One-Switch Treasures

4. Healthcare Support Systems in Assisted Living Facilities

This part of the research consisted in a user study for understanding the needs and concerns of caregivers within assisted living facilities in order to answer 3 research questions:

1. What are the current needs, concerns and desires that caregivers of ALFs for people with disabilities have?
2. How can the introduction of a healthcare support system may help caregivers and the people under their care?
3. Which features may prevent (or foster) the adoption of such a system?

To achieve this goal, three focus groups were conducted with a total of 30 professional caregivers (with different years of experience working in ALFs for adults with motor and cognitive disabilities). From a qualitative analysis of the results of the interviews emerged several unmet needs, problems and desires of the caregivers and the people under their care. Finally, stemming such findings, a set of 10 design guidelines was proposed to address the initial research questions. Also, a prototype system was designed following those guidelines to test its feasibility in-lab. Moreover, other researchers (see [2]) have already successfully used this set of guidelines as the starting point for the development, deployment and evaluation of a fully functional healthcare support system in a real ALF.

5. Conclusions

This research contributed concretely to the Accessible Human Computer Interaction community, in particular to the branches of one-switch accessibility and assisted living. The results of the studies about GNomon-based games are very encouraging, and the results of the assessment of their learnability, effectiveness, errors, satisfaction and memorability demonstrate that it is possible to create dynamic and fun video games playable through a single switch. Similarly, the design guidelines that address the specific needs of caregivers and disabled adults within ALFs constitute a valuable asset for future researchers.

6. References

[1] Aced Lopez Sebastian, Corno Fulvio, De Russis Luigi. 2015. Playable One-Switch Video Games for Children with Severe Motor Disabilities. In the 7th International Conference on Intelligent Technologies for Interactive Entertainment. IEEE, 176-185.
[2] Corno Fulvio, Monge Roffarello Alberto, and De Russis Luigi. In Computer Software and Applications Conference (COMPSAC), 2016 IEEE 40th Annual. (In Press).