Portuguese Tradition Inspired Exergames for Older People
Strategic Tools to Promote Functional Fitness

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1 OBJECTIVES

Populations are becoming older in developed countries with the low birth rates and increased life expectancy. A third of the European population is estimated to be over 65 by 2060 (European Commission, Economic and Financial Affairs, 2012). At the same time, sedentary lifestyles are the 4th mortality factor worldwide (World Health Organization).

Exergames, exercise video games, have been under research as an application of technology that can help older adults to keep physically active independently, having impact in both physical and cognitive functions (Anderson-Hanley et al., 2012; Molina et al., 2014). In this paper, we summarize a set of four exergames for older people that are designed to provide functional fitness training and can be deployed in a senior gymnasium.

2 METHODS

To produce exergames that would have a positive and significant physical impact in our players' life, we started by grounding them on health requirements. From the Senior Fitness Test framework (Rikli and Jones, 2013), we identified the most relevant dimensions to be trained as: motor ability (balance, agility and flexibility), aerobic endurance and muscular strength (lower and upper limbs, and trunk). A set of exercises to be incorporated in the games was developed by sport science professionals based on these dimensions.

The technical setup of our exergames can be seen in Figure 1, where a Kinect V2 camera is set in front of the user to capture his/her motion and serve as game controller. A projector is pointed to the floor to act as display.

Through several brainstorming sessions, we chose to develop the games under the umbrella scenario of a national tour of Portugal, where each game would replicate characteristics of individual regional traditions. Three elements - health requirements, technological setup, and scenario - were used as foundation and a development game jam was organized. This included the participation of three videogame designers, three graphical artists, two psychologists, two sport science professionals, five programmers and three games for health experts. A set of four game prototypes where developed. These were tested to collect qualitative feedback on what to improve in the prototypes with nine users (8 females; age: M=62.3, SD=6.2) and two trainers of an elderly gym. This feedback was analysed and integrated into the final version of our exergames.

Figure 1: Exergame system during one of the tests.

3 RESULTS

The following four games where developed:

Grape Stomping – Based on the Douro region of Portugal, it is an aerobic endurance game that recreates a grape maceration activity, intended for wine production. This game provides an interactive "stepable" display, presented in Figure 2 A). Grape bunches are continuously brought into the game area and the user must pull them into the wooden vats by performing an arm flexion-extension. Then the user must stomp them by repeatedly raising the knees to an adjustable height, mimicking a march in place exercise. Additional customization is offered by setting the treadmill velocity, duration and cognitive

Figure 2: A) Grape stomping; B) Rabelos VR; C) Toboggan; D) Exerfado.

challenges such as the presence of distractors and the need to follow recipes of different types of grapes.

Rabelos VR – Inspired in the Portuguese city of Porto, this game features the historic Rabelos boats, used to transport wine down river. Users control the boat and must collect wine barrels from the river side docks while avoiding obstacles, see Figure 2 B). The main training component is upper limb muscular strength which is promoted by the need to do a rowing motion with the arms to keep the boat advancing. Lateral control can be either made from lateral movement of the player or leaning of the trunk. To transfer the wine barrels to the boat, the player must turn the trunk towards the dock and make an extension-flexion movement of the elbow. Game customization parameters are the intensity of the rowing exercise and the distance between obstacles.

Toboggan Ride – Is a exergame for static balance and trunk muscular strength training inspired on the historic two-seater wicker sledges from the city of Funchal. The goal of the game is to drive the toboggan downhill, collecting game points while avoiding obstacles like pedestrians and cars, shown in Figure 2 C). Trunk leaning is used to control the toboggan, leaning laterally will move the toboggan perpendicularly to the road, leaning forward or backwards will accelerate or decelerate respectively. Alternatively, the game can be configured to control the toboggan through lateral user motion instead of trunk leaning. The distance between obstacles can also be customized.

Exerfado – A lower limbs muscular strength training game based on the traditional Fado houses from Lisbon. The game features a Fado house interior as background and a piano keyboard in the foreground, presented in Figure 2 D). Coloured musical notes fall along the same coloured lines into the piano keys, meanwhile the user must step on that key when the note hits it to be successfully played. Some notes follow the wrong tracks and are represented in black with an arrow pointing to which adjacent track they should be moved to; the user must perform an arm swipe in that direction to do it. Customization is possible by music choice, percentage of notes to be played and their speed.

4 DISCUSSION

In this work, we present the efforts and results in creating a suit of exergames for older adults functional fitness promotion. Attention was given to the exercises to be performed while playing, making sure they were age appropriate and meaningful for each fitness dimension of training. Additional effort was made to create games that our target population would be interested in playing, by choosing settings and activities that they are attracted to and by further adapting the games according to feedback provided from testing sessions. The results were four exergames ready to be deployed in a communal space for older adults. Future work will consist in the validation of the exergames. We want to automatically adapt the game difficulty to players' levels of fitness and assess the effect on functional fitness through a controlled longitudinal study.

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