Kung-Fu Kitchen: A Physical Therapy Game to Remedy the Negative Consequences of Spasticity

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Overview

Spasticity is a motor disorder defined by involuntary muscle contractions, resulting in uncoordinated gait, stiff body posture and shortening of range of limb movement. The first line treatment of spasticity is physical and occupational therapy, involving physical exercises that focus on stretching and strengthening of muscles. During the Theraplay project, we developed Kung-Fu Kitchen, a game that builds upon these physical exercises and aims to remedy the negative consequences of spasticity.

In order to design Kung-Fu Kitchen, we relied on a participatory design method, involving physical and occupational therapists from two special education schools, one clinic for Multiple Sclerosis patients, and one center for people with mental and physical impairments. Over a period of two years, we co-designed and developed game concepts and prototypes that were subsequently improved upon through an iterative development process and user tests (Vanden Abeele et al., 2012).

The Games

Kung-fu Kitchen includes the following games:

Catching Dishes

This mini game requires players to catch flying dishes at the edge of the screen and put them on a pile in the middle. The physical exercise focuses on the extension of the elbow and exorotation of the shoulder. As for the sensor technology, this is realized by a webcam in front of the patient. The tracking of hands is done via OpenCV's CAMSHIFT algorithm. The communication between OpenCV and Unity3d is done via a C++ plugin.

Serving Clients

This mini game requires players to hold drinks on a serving plate and bring them to the guests. The physical exercise relies on the extension of the elbow and the supination/pronation of the wrist/hand. As for the sensor technology, this is realized by a combination of the webcam and the acceleration sensors in the Wii remote.

Flying Dragons

This mini game requires players to fly a dragon, collecting feathers by steering the dragon to the left and right. The physical exercise relies on a transfer of weight and balancing of the center of gravity, strengthening muscles of the back. As for the sensor technology, this is realized by strain gauges inside the balance board.

Collecting Eggs

This mini game requires players to collect eggs by jumping from mountain tip to mountain top. The physical exercise allow for a triple flex (stretching of foot, knee and hip). This is realized by three Wii remotes with Wii Motionplus positioned on the foot, lower leg and thigh. Kalman filtering is used to estimate the orientation of the Wii remote from gyroscope and accelerometer. The Wii remote is addressed via the WiimoteLib. The connection between WiimoteLib and Unity3d is made via sockets.

Preparing Dishes

This mini game requires players to select ingredients from the side of the screen, and throw them in the cooking

pot in the middle. The physical exercise focuses on a rotation of the head in a horizontal plane and/or bending forward of the neck. As for the sensor technology, this is realized by the infrared camera of Wii remote, positioned on the head.

Therapy Assessment

Theraplay allows therapists to set difficulty levels separately for cognitive and physical challenges, accommodating for a variety of impairments. Additionally, an assessment module for the therapist allows for monitoring the patient's progress.

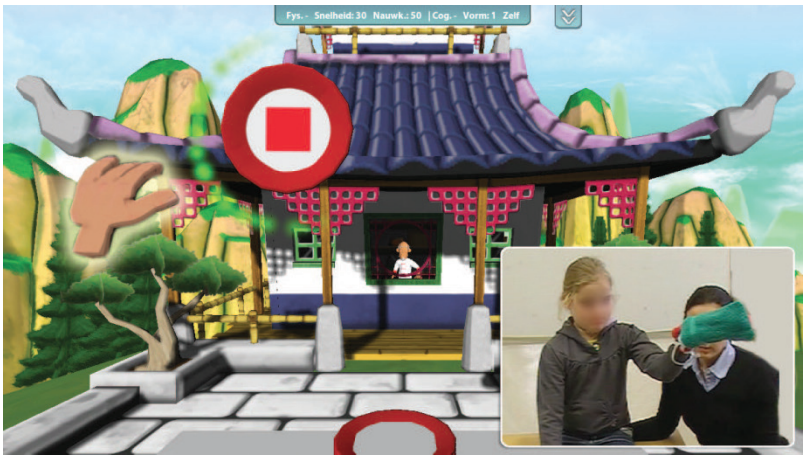

Figure 1: Picture of the Cathing Dishes game.

More information about the game can be found here: http://www.bobdeschutter.com/?page_id=1426. If the video does not work then please access it directly through this link: http://bit.ly/1aFab5F. (The video is in Dutch but there is gameplay footage near the end.)

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References

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