

# Video-games based autonomous safe rehabilitation at home under asynchronous supervision by a hospital

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## Introduction

Health providers budget cuts and increasing evidence that intensive rehabilitation can provide functional recovery also months after a stroke, both call for solutions that would enable patients to exercise autonomously at home with periodic evaluation by therapists. The IGER (Intelligent Game Engine for Rehabilitation) game engine, developed under the REWIRE FP7 project, integrates a virtual therapist (VT), based on artificial intelligence, that provides unique functionalities aimed to make exercising safe and effective: the virtual therapist. Patient's movements are continuously monitored using a fuzzy system (leveraging the therapists' knowledge) to avoid wrong postures or wrong movements, which would make rehabilitation more harmful than useful. A novel color coding feedback is used to inform the patient on wrong movements. The VT accompanies also the patient through the therapy, advising him/her throughout the rehabilitation process.

## Methods

A suite of 17 mini-games (exergames, that are games whose purpose is to promote exercising) targeted to posture and neglect rehabilitation has been realized with IGER. The games have been built upon the exercises defined by the therapists. For posture rehabilitation the different exergames cover different goals: strength exercising as well as balance control, and different levels of challenge: from learning to stand straight with weight balanced to shift the trunk and stepping in different directions. Music, chosen by the patient, is played in the background. All the games share the same theme and the same features to provide to the patient a unified experience. The gameplay has been made completely adaptive to match actual patient ability: five levels of difficulty have been pre-defined, but parameters can be tuned on a single basis in case of need. Monitoring is defined according to the single patient's needs and it is associated to each exercise. We report here an example, more examples will be shown at the conference. The exergame "Scare-crow" guides the patients to stand still with body weight equally distributed between left and right. In this game, birds fly by over the patient's avatar and rest on its shoulders. When the body weight is not balanced, birds are scared and fly away and the patient loses points. In this exercise patients have not to bend either their knees, or their spine or neck. If this happens, the associated segment of the avatar changes color from green to yellow to red. If bending of one of the segments is too much, the game is paused and the VT advises the patient on his posture. The sensitivity to weight unbalance can be tuned to the actual patient's status.

## Results and Conclusion

Preliminary usability tests have been carried out in Virgen de Rocio hospital, Seville, Spain, Cireneo clinic, Vitznau, Switzerland, Besta hospital, Milano Italy. Patients played the different exergames for 3 to 5 minutes each at the proper level of difficulty chosen by the therapist. After the session, they answered a questionnaire inspired to the TAM model, aimed to evaluate the perceived usefulness and effectiveness of the system. All responses were extremely positive and support the tenure that the IGER system can indeed support prolonged rehabilitation at home. In particular, supervision by the virtual therapist was evaluated clear and effective by both therapists and clinicians. This is indeed a characteristic that is not present in exergames suites, like WiiFit, targeted to the fitness market.

## References

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