

Usability evaluation of a low-cost virtual reality rehabilitation game for stroke patients with upper limb impairment using Kinect and P5 Glove

Jayashree Arunkumar, Pilwon Hur, Kishor Lakshminarayanan, Na Jin Seo
University of Wisconsin-Milwaukee

Recent emergence of low-cost motion tracking systems such as Kinect and P5 Glove enables development of low-cost virtual reality (VR) games. Low-cost VR games have tremendous potential to assist with physical rehabilitation for patients with paralysis by motivating patients to be engaged in repetitive movements for an extended period of time. However, wide usage of such rehabilitation games would not occur unless the games are patient-friendly and liked by patients. The objective of this study was to systematically evaluate usability of a low-cost VR kitchen game utilizing Kinect and P5 Glove using the House of Quality technique [1].

The House of Quality matrix was constructed based on patients' general expectation on VR rehabilitation games (perceived importance of each criterion, left column of Fig.1) and their evaluation of the kitchen game (rating per criterion, right column of Fig.1) which were obtained from six stroke patients on a Likert scale using questionnaires before and after they experienced the kitchen game on their own, respectively. As an outcome, priority weights were computed based on these weights and ratings as well as the interrelationship matrix (shown in the middle of Fig.1).

The results indicated that the top priority improvement needs are to introduce various difficulty levels in the game and to add clinical assessments (red priority weights on the bottom row of Fig.1). Based on the observation during the gaming experience and focus group discussion that took place after the questionnaires, it was found that patients would like the game to accommodate individuals with different motor functions by introducing multiple challenging levels in the game. In addition, the patients would like the game to periodically assess their motor function based on known clinical assessments to track their improvement over time.

In conclusion, introduction of difficulty levels per patient's current motor functions and addition of clinical assessment to track clinical benefits from using this game are expected to substantially increase usability of this VR kitchen game. This study demonstrates a feasibility of the House of Quality technique to

systematically evaluate usability of a VR rehabilitation game and identify the top priority improvement needs.

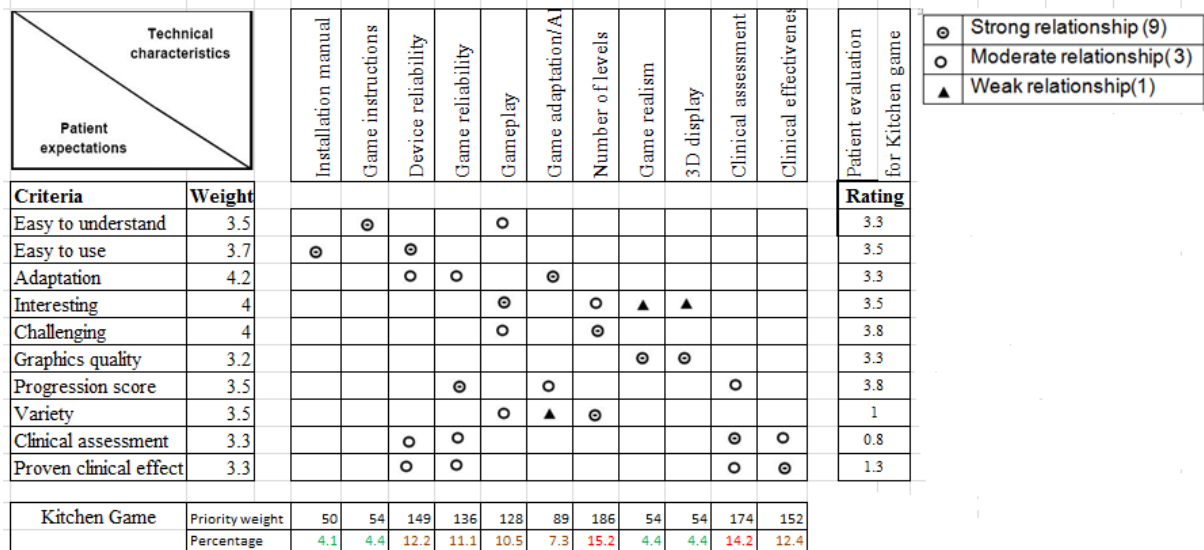


Figure 1: The House of Quality matrix for a low-cost VR Kitchen game identified top priority technical improvement needs as an outcome (bottom row), based on patients' expectation ratings (left column), the game's technical characteristics (top row), interrelationship matrix (center), and patients' evaluation of the game (right column). Red, brown, and green numbers indicate the highest (>14%), intermediate, and the lowest (<5%) technical improvement priorities for the game, respectively.

Reference

Crocher V, Hur P, Seo NJ. "Low-cost virtual rehabilitation games: House of Quality to meet patient expectations", *International Conference on Virtual Rehabilitation*, 2013, Philadelphia, PA.

Presentation Preference: Unsolicited Poster Presentation

Awards:

- Masters Level Poster Competition: Yes**
- ASB Clinical Biomechanics Award: Yes**
- ASB Journal of Biomechanics Award: Yes**

Track: Rehabilitation