A serious games approach for upper body morbidity assessment and prevention of breast cancer patients

H.P. Oliveira*, E. Costa*, A. Guerra*, J.P. Monteiro*, S. Magalhães†, A. Magalhães†

*INESC TEC, Portugal (helder.f.oliveira@inesctec.pt) †Hospital São João, Portugal

Abstract:
Breast cancer is the leading cause of cancer in women, with an estimated 1.383.500 new cases in 2010, and an estimated 60.290 new cases in 2015 only in the USA. Nevertheless, mortality rate is equal to 27% or less in developed regions, due to effective therapies and medical procedures, as well as prompt diagnosis. Since survival rates are so high, it is important to understand the Quality of Life (QOL) of women after breast cancer surgery, and the impacts of the treatment in these parameters. Problems related to Breast Cancer are often associated with surgical procedures and postsurgical treatment, some of which can lead to several Upper Body Function (UBF) problems. However, these do not have a defined healing process, leading to lower QOL and difficulty in accomplishing daily activities. Concerns with the QOL of breast cancer patients have been growing, with several studies trying to address this problem and showing that it can be affected by several clinical problems related to breast cancer surgery, and also by psychological problems such as depression, anxiety and problems with body image. On the other hand, UBF assessment is usually performed by subjective self-reports. Even though self-reports have shown good results, these are limited and can present deceiving results. Also, the commonly used self-reports only assess UBF or QOL. This leads to a limited understanding of patients’ condition.

An important factor that causes impairments in UBF and lower QOL is the presence of lymphedema. This is common in women after breast cancer surgery where the removal of the axillary lymph node system is needed. Lymphedema can be related with pain and restricted shoulder mobility. These problems have high correlation with decreased QOL in breast cancer patients, impacting their daily activities. Still, a more premature diagnostic of such conditions allows a better management of the problems, leading to improvements in upper limb functionality and, thence, patients’ QOL. This way, after the breast cancer treatment, it is essential to maintain continuous physical activity in order to avoid lymphedema. This physical activity is recommended through a group of exercises done under medical supervision, which would imply the help of specialized professionals, diverting them from other tasks. This ends up in a waste of this professionals’ time and, in many situations, many patients end up losing their motivation and do not attend physiotherapy sessions. The new technologies have been bringing great changes in the way that people organize their personal life, as their social one as well. Technology is, sometimes, used as an important tool in health and a great contribution to improve the QOL and average life expectancy of people. Nowadays games have numerous dimensions, which allow them to be used in different contexts and with multiple functionalities. They are a dynamic and interactive tool that allows solving the lack of motivation issue and free specialized human resources for other activities.

The present work aims to create an objective method to perform this evaluation and provide a more accurate analysis of upper limb impairments. For that, a number of exercises were selected and, using Microsoft Kinect, RGB-D and skeleton tracking data was acquired. It was investigated a new rehabilitation model for patients who have had breast cancer through the use of Kinect, and develop a new application, based on serious games (see Fig. 1), that allows the patient in executing useful exercises in order to recover the surgical operated limb and, at the same time, evaluates their movement’s execution. Supervised classification algorithms were used to construct a prediction model for characterized patient condition, namely: the presence of pain, stiffness, weakness, lymphedema and functionality. Results obtained in this work were very promising for breast cancer patients’ classification, and are better than those presented in the literature, with a Miss Error Rate (MER) of 14% for pain, 8% for stiffness, 12% for weakness, 12% for lymphedema and 13% for functionality.

Fig. 1 - Snapshots of the serious games developed for the rehabilitation of breast cancer patients.

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