SUMMARY

The present study was designed to create a virtual upper extremity rehabilitation tool for people with shoulder joint movement impairments, to develop a game-based application with the help of markerless motion capture system, to implement several training activities for shoulder joint and to optimize upper extremity rehabilitation tool's application for data collection and analysis (feedback). For these aims the integration of the Microsoft Kinect 2.0 into Unity-based application for upper extremities assistance and analysis was performed. The final application contains four different games focusing on training different shoulder movements – abduction, horizontal flexion, vertical flexion, adduction/flexion. It is also possible to orient the goal and task based on the patient's abilities. The application is capable of registering the data and tracking the performance of the user. This work can be identified as an exergame that combines natural human movements supported by the entertainment of video games. Despite the fact that the game also intends to rehabilitate patients with motor-impairments while evaluating a patient's progress, the monitoring for risks of joints injury is not utilized.

The system developed in this work implements a universal software base and can be accessed and installed on personal PC-s and laptops. In addition to exploiting this game as a rehabilitation training device in the hospital, it can also be a useful home-based rehabilitation tool for the owners of a personal Kinect sensor.

To conclude, the use of virtual reality (VR) in rehabilitation has great potential for further development. Not only can it provide low-cost solutions, but it also increases the motivation among the patients. The measurement of the position and movement of the patient's limbs can be integrated through motion capture devices and utilized to provide the feedback. The present study has been one of the first projects that focused on a particular upper extremity training including all extremity joint movements. One source of weakness in this study, that can affect the measurements of skeleton movement, is the accuracy of the Kinect sensor.

Further improvement can be carried out in order to implement the monitoring of risk of joints injury and provide real-time assistance to the patient. It can be achieved by analyzing the posture of the patient; it is possible to get the body segment angles and also analyze the movements of the limbs. The mechanism can utilize the arrangement of the instruction to the patient in order to achieve the required posture for the particular exercise. Furthermore, the integration of a database can be implemented for

data storing and allowing remote access for the physician. Another step to take would be to perform tests on patients in a medical environment.