

Multimodal Interaction and AI in Rehabilitation of Rheumatoid Arthritis

Gabriela VARGA^{a,*}, Lăcrămioară STOICU-TIVADAR^a, Stelian NICOLA^a, Elena AMARICĂI^b, Oana SUCIU^b, Corina DOBRESCU^c, and Elena SÎRBU^d

^a Department of Automation and Applied Informatics, Politehnica University of Timișoara, România, P-ta Victoriei, no. 2, 300006 Timișoara, Romania

^b Department of Rehabilitation, Physical Medicine and Rheumatology, Victor Babeș University of Medicine and Pharmacy, Eftimie Murgu Str., no. 2, 300041 Timișoara, Romania

^c Private practice, Romulus Str., no. 62, 300238 Timișoara, Romania

^d Department of Physical Therapy and Special Motricity, West University of Timișoara, Vasile Parvan Boulevard, no 4, 300233 Timișoara, Romania

E-mails: gabriela.varga44@yahoo.com; lacramioara.stoicu-tivadar@upt.ro; stelian.nicola@aut.upt.ro; amaricai.elena@umft.ro; oanasuciu78@umft.ro; coridobrescu@gmail.com; elena_sarbu@yahoo.co.uk

* Author to whom correspondence should be addressed

Abstract

Currently, there are several devices used in kinethotherapy for rehabilitation and evaluation of movements, but fewer applications that support rehabilitation for people diagnosed with rheumatoid arthritis. In the past several ones were using Microsoft Kinect, other are using Leap Motion and artificial intelligence, and present gamification features. The paper presents a system for at-home rehabilitation of patients with first and second stages of rheumatoid arthritis (RA) based on multimodal interaction using leap motion, serious gaming and neuronal networks support. The system consists of an application for the doctor - who will give the diagnostic, who can view the actual patients and the deleted ones - and one for the kinethotherapist with two games matching the symptoms for first and second stage of RA. The aim of the game for RA first stage is to increase overall hand mobility through the swipe movement. The purpose of the second game is to recover the grip movement of the hand, placing some 3D models in a box. Through the neuronal network the patients can have feedback from the comfort of their home for the realized exercises. The correct movements are classified with an accuracy of 95%. The technologies used were: Visual Studio 2019, Unity 2018, C# and Python 3.7. In this moment, the application was tested by a group of 10 patients from Medical Centre Sf. Mary of Timișoara from May to June 2021. The fatigue of the fingers and wrist were, in most of the cases small, respectively, too small. Most of the users given positive feedback and confirmed that they would use the application with the aim of rehabilitation. In the current pandemic context such a system would be very useful for both: patients and healthcare workers. In this way, results would be more visible in terms of rehabilitation.

Keywords: Virtual reality; Hand rehabilitation; Leap motion; Neuronal network; Multimodal interaction