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Remote sensing technologies for physiotherapy assessment

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Abstract:
The paper presents a set of remote, unobtrusive sensing technologies that can be used in upper and lower limbs rehabilitation monitoring. The advantages of using sensors based on microwave Doppler radar or infrared technologies for physiotherapy assessment are discussed. These technologies allow motion sensing at distance from monitored subject, reducing thus the discomfort produced by some wearable technologies for limbs movement assessment. The microwave radar that may be easily hidden into environment by non-metallic parts allows remote sensing of human motion, providing information on user movements characteristics and patterns. The infrared technologies - infrared LEDs from Leap-Motion, infrared laser from Kinect depth sensor, and infrared thermography can be used for different movements' parameters evaluation. Visible for users, Leap-motion and Kinect sensors assure higher accuracy on body parts movements' detection at low computation load. These technologies are commonly used for virtual reality (VR) and augmented reality (AR) scenarios, in which the user motion patterns and the muscular activity might be analyzed. Thermography can be employed to evaluate the muscular loading. Muscular activity during movements training in physiotherapy can be estimated through skin temperature measurement before and after physical training. Issues related to the considered remote sensing technologies such as VR serious game for motor rehabilitation, signal processing and experimental results associated with microwave radar, infrared sensors and thermography for physiotherapy sensing are included in the paper.

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I. Introduction

Stroke is a common health care problem globally, and it is a leading cause of acquired disability worldwide. In 2013, worldwide prevalence of stroke was 25.7 million, with 10.3 million people having a first stroke [1]. The majority of patients with stroke, experience incomplete recovery of motor deficits despite intensive rehabilitation, with up to 60% having impaired manual dexterity, 6 months following the stroke. To recover the mobility in order to regain the independence with functional activities intensive physical rehabilitation program is required. Traditional physical therapy can be characterized as hyper-focused workout, where the goal is to work the muscles of the affected arm. Traditional physiotherapy incorporates a variety of stretching, strengthening, aerobic training, and pain-relief exercises [2]. The process is long and often painful. The outcome evaluation is usually carried out in subjective way [3] that may difficult the prediction of the required training period for motor performance improvement. The new developments in the field of sensorized equipment for physical therapy [4] [5] made possible the physical rehabilitation session records and reports generation that can be useful for the implementation of objective evaluation of patient evolution during the rehabilitation period.

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