

DEVELOPMENT AND MODELING OF A BIOMECHATRONIC SENSOR EFFECTOR BOOT DEVICE

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Abstract: *In this paper we represent the development of a sensor effector boot mechatronic device for effective rehabilitation of patients in the early post-traumatic stage (1 month) after the occurrence of a serious spinal-cord trauma or poli-trauma. The device is portable with insurance for vertical position in the bed of the immovable patients. The device includes: a module for basing and fixation of the patient's leg, a sensor "SkinTouch" for measuring bio-electrical impedance in points on the skin of the foot, a mechanism for acupressure, a module for basing of a measuring sensor and a mechanism for acupressure, and also gives the possibility for their connection to various foot points for the programme performance of the procedures and PC controlled sensor and effector elements, connected to the physician's monitor.*

Keywords: *boot mechatronic device, sensor, effector, rehabilitation, paraplegics.*

1. Introduction

Perspective and necessity of investigation on new sensors and effector mechatronic devices and technologies for locomotion rehabilitation are based on the results from the investigations on the physiological control locomotion mechanisms of humans and animals, performed in the Institute of Physiology "Pavlov" PAN (Gerasimenko et al., 1999), (Nikitin et al., 2001). Perspectives for a positive result of the rehabilitation at the locomotion pathology are derived in these investigations, as a result of a spinal cord trauma, main brain diseases or continuous muscle inactivity. At this stage a very important fact appears the application of the tactile feet stimulation of the injured limbs. One of the methods of restoring the support-locomotion functions is to affect the neurons of the spinal cord using the limb reception system as a natural communication channel. Foot receptor activation is applied for that purpose.

2. Methods

Developed mechatronic boot device can ensure treatment procedures by foot receptor activation on method of acupressure, combined with methods of reflexotherapy. It operates according to a previously prescribed program for acupressure at specific foot points, receptor activation along specific trajectory or affects foot reflex areas. The device can ensure control measure the bioelectrical resistance by means of a specialized sensor (Platonov et al., 2010). Such a sensor is needed to design a high-spatial resolution map of acupuncture points of a patient's foot, and the map should be used to analyze the results of the treatment.

Product "Mechanical Desktop 2005" is applied for the creation of a virtual 3D model of the module. The program "MSC.visualNastran 4D 2002" for computer simulation is applied on the 3D model.

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3. Design and modeling of the modules of mechatronic sensor effector boot device

The device includes: a module for basing and fixation of the patient's leg, a sensor "SkinTouch" for measuring bio-electrical impedance in points of the foot skin, a mechanism for acupressure, a carriage module for basing of a measuring sensor and a mechanism for acupressure, a module for a plane motion and positioning of carriage module to various foot points for the programme performance of the procedures and PC controlled sensor and effector elements, connected to the physician's monitor.

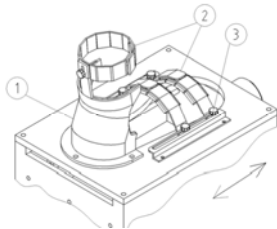


Fig.1: A module for basing of the patient's leg

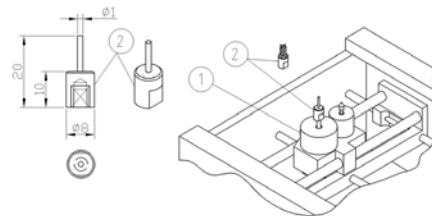


Fig. 2: A mechanism for acupressure

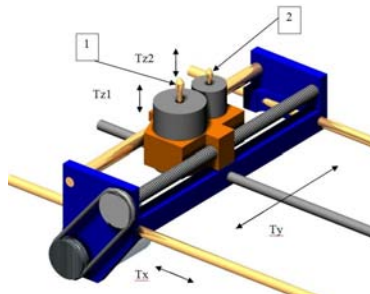


Fig.3: 3D model of mechanism for a plane motion and positioning of carriage for measurement and acupuncture

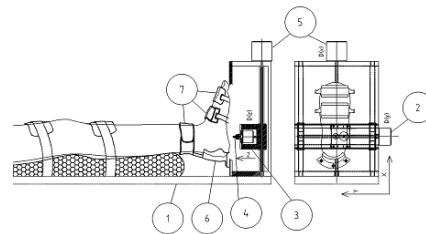


Fig.4: General view of the device

4. Conclusions

The conclusions derived after modelling and simulation help the successful realization and approbation of the separate modules and the prototype of the new device.

The program is derived for the performance of the rehabilitation healing by means of the new portable mechatronic device.

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