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Escuela Académico Profesional de Ingeniería Eléctrica

Tesis

Electronic and Mechanical Design of an Exoskeletal Structure Prototype to Contribute to Partial Rehabilitation

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Electronic and Mechanical Design of an Exoskeletal Structure Prototype to Contribute to Partial Rehabilitation

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***Abstract*— This research develops a proposal for the mechanical and electronic design of an exoskeleton type robotic prototype that aims to contribute to the partial rehabilitation of the hand through muscle sensors (EMG), to detect the patient's intention to move and achieve an adequate rehabilitation routine, the development methodology is based on three stages. The first stage is the electronics where the control circuit is developed and the simulation of the muscle sensors (EMG) for the activation of the linear actuators, in this stage a motion registration circuit is also developed that is reflected on an LCD screen, The second stage is the mechanics that studies the biomechanics of the hand for the creation of the design of the links of the external and internal phalanges generating the extension and flexion of the fingers of the mechanism, and the third stage is the integration of the mechanical and electronic system that describes all the components that make up the system. The simulation of the Von Mises stress analysis in the SolidWorks software with the PET type plastic composite material was obtained as results, the parts of the exoskeleton withstood the applied loads, maintaining that the prototype design has the ability to hold and support the fingers.**

Keywords*— Exoskeleton, muscle sensors (EMG), biomechanical, mechanical design, electronic design.

I. Introduction

The loss of mobility in the extremities of the human body is often due to poor rehabilitation practice, since each patient needs a different process, but since the creation of electronic devices, accurate diagnoses can be made and a rehabilitation routine determined. suitable [1].

The development of exoskeletons focused on medicine grows every day, the first exoskeleton created has not yet been specified, but the first exoskeletons were completely mechanical that helped to perform some activities [2]. The growth of electronics and sensors empowered these robotic devices making them more versatile [3].

Partial paralysis or numbness of the hand is frequently caused by different diseases such as nervous system disorders, fractures, and damage to the main tendons of the hand. Rehabilitation treatments are generally traditional and sometimes the results are negative due to lack of commitment of the patients in the session and a wrong diagnosis [4]. There are many exoskeletons for hand rehabilitation, but most do not use sensors that detect the patient's intention to move, which makes the rehabilitation process take more time [5].

The proposal of this article is to make a mechanical design prototype that has adduction, abduction, flexion and extension movements of the fingers, with an integration of EMG sensors that will help identify the patient's intention to move by sending the signal to a controller. Arduino Uno for data processing and determining the proper drive of the linear motors, the exoskeleton of the hand will also have an LCD screen to program routines and record the patient's movements, this provides a complete and personalized rehabilitation process.

II. Methodology

The methodology used in this research will have three stages of work, stage 1 is the electronic design where the interactions of the sensors with the controller will be detailed, stage two is the mechanical design where the structure of the links that They make up the exoskeleton mechanism and stage 3 is the interaction between the mechanical and electronic part where the location of each component is detailed.

A. Electronic Stage

In the electronic design, it is important to create a circuit with an EMG signal filtering system. It is very important to filter the signal to activate the proper actuator based on the intention of the patient's movement. In this way, the control system is achieved, in Fig.1 shows the location of the EMG sensors.

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