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# MOVEMENT IDENTIFICATION AND SUPPORT DEVICE FOR THE RIGHTARM FOR PERSONS WITH MOBILITY PROBLEMS

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## ABSTRACT

NOVELTY - The device has an elbow whose flexion or extension is provided for supporting and achieving by a supporting rod, an actuation motor, a gear wheel system, a transmission belt and a rod that supports a forearm of the mobility-impaired person. The electromyography sensors are provided for detecting the intention of moving at the muscular level together with inertial sensors for determining the angle at which the arm of a mobility-impaired person is positioned. The shoulder and the elbow of the mobility-impaired person are actuated based on data acquired from the two sensors.

## KEYWORDS

Hand tools,
Process and Machine Control,
Inertial sensor,
Electromyography sensor,
Person with impaired mobility

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## INTRODUCTION

The invention aims to create a device to identify and support the movement of the right arm for people with mobility problems. The device is controlled on the basis of the movement intentions of the muscle tissue where the muscle has a minimum degree of activity but does not have enough strength to support the movement of the arm, especially if it performs the manipulation of objects. The device presented can be used both in recovery centres and at the patient's home.

## RESULTS

Currently, people who have mobility problems, especially as a result of an accident, benefit from the support of orthotic devices, which are applied to a segment of the body to prevent or correct the malfunction of that segment. These are generally mechanical devices designed to support, protect or immobilise the affected areas. In rare cases they are also fitted with a actuator.

The exoskeleton device has a rectangular metal structure. It shall be positioned parallel to the back of the person with mobility problems. The first movement of the device is carried out by a trapezoidal screw together with the drive engine and the two support bars. These support bars are positioned at equal distances from the trapezoidal screw with which they support the flexion/extension movement of the shoulder. The second movement that the device supports is that of rotating the shoulder. The device then contains the support rod, the second engine, the gear system, together with a transmission belt, which has as its main role in this system the support and performance of the shoulder induction/abduction. The third movement is carried out in the same way as the second, supporting and performing the flexion/extension of the elbow, being provided by: the support rod, the drive engine, the gears, the transmission belt and the forearm support rod.

The system's driving algorithm is based on electromyography sensors (EMG) to detect the intention of movement existing at the muscle level together with inertia sensors to determine the angle at which the arm is located. Depending on the data purchased from these sensors, the decision is taken to move the entire device, which consequently acts the shoulder and elbow. When the signal at the muscle drops below a certain value, the entire system stops due to a lack of intent in order to support the position in which the arm has reached.

Electromyography sensors are active throughout the life of the device, while the inertia sensors are for the calibration of the device and are used only for this purpose.

Figure 4 shows the device control algorithm. Thus, the EMG sensors detect electrical activity in the muscles and transmit the EMG signal to the motion identification block. It contains the system identified from the calibration phase, in which the correlation pattern between the EMG signals and the angles of movement of the arm elements is performed. Through this model the motion identification block determines the angle of motion and transmits it further. It is taken over by the block containing the direct mathematical model of the human arm and, on the basis of calculations, the position of the wrist is determined as a result of the movement of the arm elements with the specified angles. The position of the wrist is taken over by the block containing the reverse model of the exoskeleton, which, on the basis of calculations, determines the translation and angles of motion for each element of the exoskeleton. Knowing these angles, the exoskeleton drive block transmits the control signals to the exoskeleton actuators, thus bringing the final element of the exoskeleton to the user's wrist. Thus, the user can have a support/rest point whenever he feels the tired arm.

This device does not achieve the movement of the user's arm, only follows its movement to be support in case of tiredness of the user's muscles.

The main advantage of the proposed system is to support the movement of persons with mobility problems who, with the help of this device, have the possibility to use their right hand to perform various movements of arm abduction/aduction, flexion/extension of the arm and flexion/extension of the forearm necessary for daily activities.

The device can be used in the stand in specialized recovery centers at the patient's home, but it can also be attached to a wheelchair.

Another advantage of the device is that it does not move the user's arm only provides support to the device, which means that it does not interfere in the active use of the user's muscles or force the user's arm.

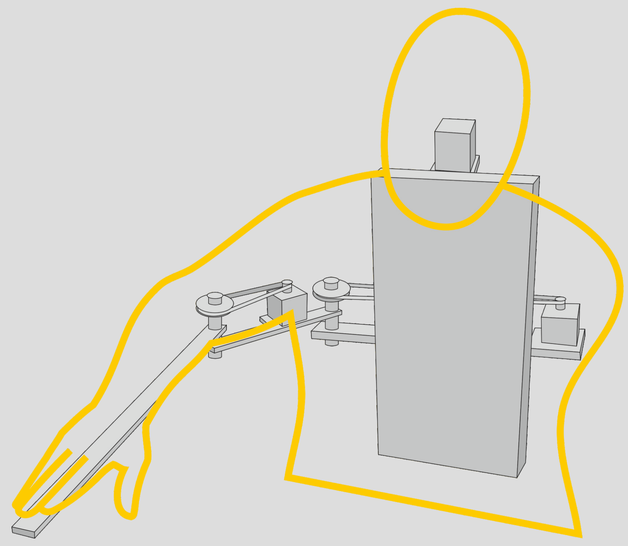

**Figure 1.** Exoskeleton scheme – front view

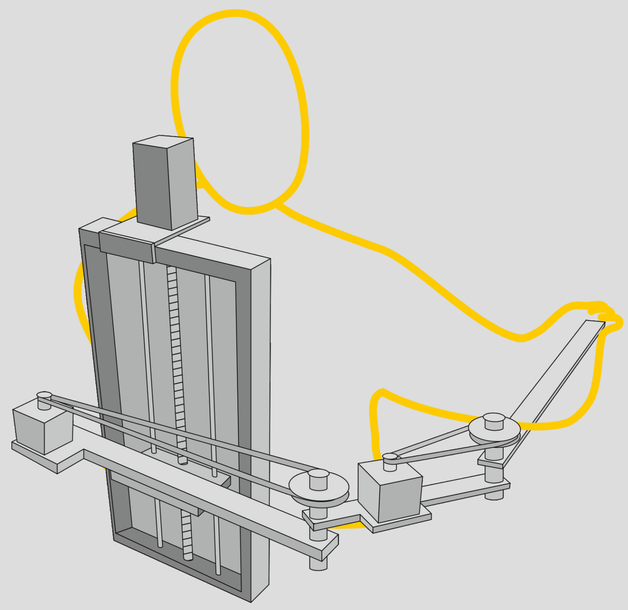

**Figure 2.** Exoskeleton scheme – rear view

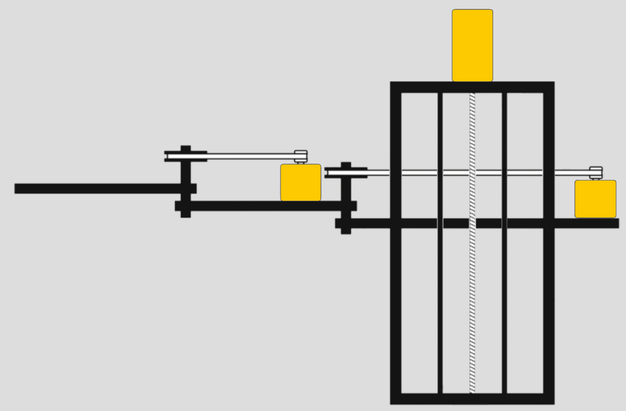

**Figure 3.** Device block scheme - front view

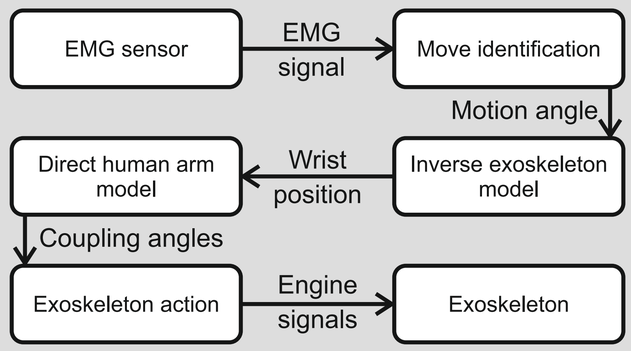


**Figure 4.** Algorithm logic scheme