Journal of Ergonomics

Munoz, J Ergonomics 2018, 8:1
DOI: 10.4172/2165-7556.1000e176

Editorial Open Access

Ergonomics in the Industry 4.0: Exoskeletons

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Received date: Jan 26, 2018; **Accepted date**: Jan 29, 2018; **Published date**: Jan 31, 2018

Citation: Munoz LM (2018) Ergonomics in the Industry 4.0: Exoskeletons. J Ergonomics 8: e176. doi: 10.4172/2165-7556.1000e176

Editorial

The environment around Industry 4.0 should allow new paradigms for people and machines to work efficiently and safely given the growing boom in the interconnectivity of the elements involved, and the new roles that people acquire in this environment in revolution. Collaborative Robots [1] it is an example, which share with people the same space work to carry out tasks contributing each part with the best of both worlds.

Another example, close to the robots, are the exoskeletons, which form a kinematic chain in close contact with the human body. These exoskeletons can provide support, rigidity, protection or augmentation of strength and/or sensitivity. Exoskeletons can cover lower limbs, upper limbs or both. They can be passive, providing support or protection, or they can be active, providing additional strength. There is an extensive methodology from the Robotics science that allows the modelling and control off these systems [2].

The use of exoskeletons has been widely studied in the field of rehabilitation [3] both for upper [4] and specially for lower limbs [5,6], but their demand is also growing in the industrial sector.

An example of upper body exoskeleton has recently been tested [7] in the automotive industry to assist operators who perform overhead operation repetitively and for long periods of time. These devices provide a support for the arms to be able to lift them with or without tools with easiness thanks to a predetermined vertical thrust. This type of assistance allows to reduce the load on the joints and muscles, improving the quality of life of the worker, both physical and mental, also achieving a better quality of work.

Also in the automotive industry, an example of passive exoskeleton for the lower limbs [8] is being tested to assist workers who have to work standing up continuously, acting as a chair when the worker wants to rest, reducing the load on the legs and facilitating a postural correction on the back, but remaining on the body facilitating the mobility of the person.

An example of an active exoskeleton that covers upper and lower limbs is the HAL robot [9] which, given its characteristics, has been proposed to be used for operations in nuclear power plants [10].

For evaluation purposes and ergonomic design of the exoskeletons, some authors propose a set of bot objective [11] and subjective [12] metrics. Objective metrics are based on how the subject perceives the performance of the task, comfort as well as the index obtained from NASA TLX test. The use of 3D scanning techniques is also being used for the customized ergonomic design of exoskeleton structures [13].

The close link between the exoskeleton robots and the human body requires the study of these systems from multiple points of view, requiring scientists from the areas of technology and health to work side by side for a successful evolution.

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