Haptic interface exoskeleton with virtual and/or augmented reality environment

KEYWORDS

- ❑ GAMING
- ❑ WEARABLE
- ❑ REHABILITATION
- ❑ VIRTUAL REALITY
- ❑ SIMULATED DYNAMICS

AREA

- ❑ CIVIL, CONSTRUCTION & MECHANICAL ENGINEERING

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Patent Type
Patent for invention.

Ownership / Co-Ownership
Sapienza University of Rome 12%, INAIL-Central Research Department 60%, University of Tuscia 12%, University of Naples Federico II 6%, Niccolò Cusano University 10%

Inventors
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Industrial & Commercial Reference

Training in virtual reality, gaming, explorative telepresence, wearable robotics, rehabilitation, simulated gravity in outspace navigation or permanence in microgravity.

Time to Market
TRL is 6

Availability
Licensing, Experimentation, Collaboration, Start-up business

Fig 1. SIDE exoskeleton in front view on his support.

Fig 2. Detail of SIDE robotic arm

Abstract
Bi-articular upper limb exoskeleton interfaced with virtual or augmented reality systems. It is simulate upper limb force/contact interaction scenarios in a controlled virtual environment. The robotic device is wearable, attached to the subject's body and connected with the upper limb at two points, arm and forearm. It is capable of transferring controlled forces to the arm and forearm in order to reproduce the mechanical load applied to the shoulder and elbow joints by simulating interaction with the virtual environment, e.g., lifting objects, manipulating tools, opening/closing valves, bumping into walls.Translated with DeepL.com (free version)

Technical Description

The device consists of two main sections: the corset and the robotic arm. The robotic arm consists of 4 motors, placed on the 4 joints, and 4 links. The links are made of light alloys, carbon fiber, and PLA by 3D printing. There is a joint with the subject's arm by means of a cuff shell, as well as a fourth joint with the forearm. The degrees of freedom provided by the 4 joints allow stresses (moments) to be applied to the shoulder joint in its 3 anatomical planes, allowing the subject to make as many free rotations with the shoulder, and to lift the glenohumeral joint unimpeded. The last joint of the kinematic chain allows the application of a flexion-extension moment from the elbow, and allows the same rotation to the same.

Technologies & Advantages

The goal of the device is to provide haptic feedback to the subject, thereby increasing the "immersiveness" of the virtual reality scenario with which they are interacting. This has as its main, but not exclusive, objective to increase the effectiveness of worker/operator training conducted in virtual reality, with a focus on operators in confined and/or pollution-suspect environments. The possibility of creating virtual scenarios, varying for training purposes the level of difficulty/dangerousness reproduced, constitutes the enormous advantage offered by virtual reality, making it possible to increase the numerosity and complexity of scenarios, cut costs, and limit or eliminate risk during training.

Applications

Application areas include: Virtual reality training, gaming, exploratory telepresence, wearable robotics, and rehabilitation. Recently, virtual reality scenarios have had an increasing impact on our daily lives. As a result, there has been a great expansion of the area of interest in recent years, especially that concerning the enhancement of technologies for the reproduction of sensory stimuli. Possible industrial stakeholders include all companies involved in the metaverse, virtual reality, advanced training tools and neuro-muscular rehabilitation.

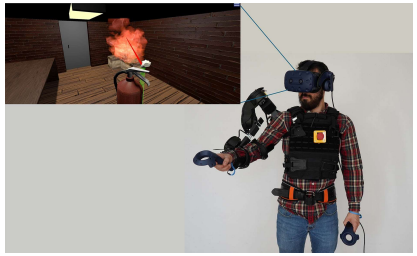

Fig 3. The subject is handling a fire extinguisher while they feel the weight through SIDE haptic feedback.

Fig 4. Lateral view of the subject wearing SIDE. You can see the backpack containing the control electronics.

Fig 5. Back view of the subject wearing SIDE with the electronics backpack opened.

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