“BIOMEDICAL DEVICE FOR ROBOTIZED REHABILITATION OF A HUMAN UPPER LIMB”

Summary
The present invention relates to a biomedical device for robotized neuromotor rehabilitation of the shoulder and elbow joint of a human body.

Background
Nowadays, in order to improve and optimize techniques of neuromotor rehabilitation of the human body limbs, it is known art to use motorized systems allowing the patient musculoskeletal apparatus to follow physiological movements, while at the same time providing the most extensive breadth of movement, which the limb affected by the rehabilitation is capable of.

In particular for the rehabilitation of the upper limb, biomedical devices of the motorized type comprise an exoskeleton that can be fitted over it, helping the patient to perform the movements necessary for the rehabilitation, thanks to a plurality of electric motors. This type of devices suffer of two critical aspects: 1) kinematic singularity of the exoskeletal structure in the event of complete extension of the forearm; 2) approximation of the movement of the shoulder girdle and thus of the real center of instantaneous rotation of the arm.

The present invention refers to a biomedical device of said type, that overcomes said limits and provides, at the same time, a greater capacity for movement, with respect of conventional devices available up to now; it is simple to implement, easy to use and at low cost when compared to conventional biomedical devices. The developed kinematic structure can also be exploited to realize a passive, unactuated and gravity-balanced exoskeleton, helpful to support the patient’s arm with a lightweight and cost-effective solution, largely exploitable by patients with some residual motion abilities.

Technology
The present invention refers to a biomedical device that comprises two rigid rods, associate respectively with forearm and arm of the upper limb of a patient by way of joints with four degrees of freedom - of which three are rotary and one is translational- and aligned with the longitudinal axis, respectively of said forearm or of said arm. A particular and innovative arrangement permits to prevent a condition of kinematic singularity during alignment between said forearm and a said arm.

The technical characteristics permit to use said biomedical device on patients having different anthropometric values.

Stage of Development
A prototype of exoskeleton has been developed in two different variants.

The first one enables a patient to move the upper limb passively supporting its mass, thanks to a spring-based gravity-balanced mechanism. Comparing to the conventional biomedical devices, it enables not only a better limb mobility, but also a domestic use and a lower cost.

The second one is a robotic exoskeleton that enables the execution of assisted movements; comparing to the already developed devices, it allows the patient to achieve a wider range of motion and much more comfort.

Trends
Biomedical equipment and devices are more and more used in order to treat bony, muscular and neurological disorders in rehabilitation therapy. They are a very important therapeutic instruments, for clinical as well as domestic use. Unlike the classical pharmacologic treatments, they have few contraindications and collateral effects.

Technology offer
- Biomedical device for robotized or passively gravity-balanced neuromotor rehabilitation of the shoulder and elbow joints

Patent applicant
- National Research Council (CNR) - IT

Industry sectors
- Physiotherapy and rehabilitation

Applications
- Rehabilitation of upper limb of human body

Advantages
- The peculiar kinematic structure allows a wider mobility of the elbow joint and a highly human-compatible motion of the shoulder joint, if compared to currently existing exoskeletons.
- The kinematic scheme can be effectively exploited to realize a passive gravity-balanced exoskeleton, to support the upper arm mass and facilitate rehabilitation exercises.
- Rapid reconfiguration in order to be used both for the rehabilitation of the right limb and of the left limb
- It can be provided with adapted sensors of force and torque for performing advanced rehabilitative exercises.

Intellectual property rights

Offer
- Patent license
- Patent sale
- Executive drawings
- Know-how