Patient-Tailored Assistance

A New Concept of Assistive Robotic Device That Adapts to Individual Users

IMAGE LICENSED BY INGRAM PUBLISHING

By Ricardo Morales, Franciso J. Badesa, Nicolas Garcia-Aracil, Carlos Perez-Vidal, Jose M. Sabater, Eugenia Papaleo, Antonino Salerno, Loredana Zollo, and Eugenio Guglielmelli

This article presents the development of a new concept for an assistive robotic device that can help people as needed, considering their residual physical and cognitive abilities, and, at the same time, increase their cognitive and physical abilities in activities of daily living (ADLs), such as drinking, cooking, eating, personal hygiene, and grooming.

According to the United Nations, life expectancy will continue to rise all over the world. In the more developed regions, the population aged 60 or older is increasing at the fastest pace ever (growing at 2.4% annually) and is expected to increase by more than 50% over the next four decades, rising from 274 million in 2011 to 418 million in 2050 [1].

Among age-related pathologies, cerebral vascular accidents, also known as strokes, are the leading cause of permanent disability in the industrialized nations. More than 536,000 Europeans and 780,000 North Americans have a stroke each year; more than 50% survive, but they are often severely impaired [2]. People who have had a stroke can be classified, according to their stage, as acute, subacute, or chronic patients. Although most of the recovery process after a stroke takes place in the first three months, recovery might continue over a longer period of time in patients who have not reached their full potential recovery.

During the last few decades, a great variety of assistive robotic devices have been developed using different approaches: from robots with a fixed base, attached or not to a wheelchair (e.g., the iARM manufactured by Exact Dymanics and previously known as MANUS [3]), to mobile autonomous systems (e.g., three generations of Care-O-bot from Fraunhofer IPA [4]). In this article, a new concept of assistive robotic device is presented; it is a seven-degrees-of-freedom (7-DOF) assistive robot arm that, provided with a multimodal human–robot interface (HRI), is able to 1) measure the user's physiological and biomechanical state, 2) adapt the robot's behavior accordingly, 3) enable the execution of assisted three-dimensional (3-D) ADL tasks, and 4)

Digital Object Identifier 10.1109/MRA.2014.2304051
Date of publication: 10 September 2014