Method for patients with motor disabilities to choose a command through a graphical interface, related system and IT product.

KEYWORDS

- ASSISTED HUMAN-COMPUTER INTERFACE
- MOTOR DISABILITIES
- PERSONALIZED ASSISTANCE
- MODEL PREDICTIVE CONTROL
- MACHINE LEARNING

AREA

- BIOMEDICAL

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Patent Type
Patent for invention.

Co-Ownership
Sapienza Università di Roma 80%, Istituto Superiore di Sanità (ISS) 20%.

Inventors
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Industrial & Commercial Reference
Software/hardware development for augmentative and alternative communication.

Time to Market
After a first validation performed on a limited number of volunteers, the next campaign is scheduled over the next 6 months on a group of patients.

Availability
Research, Development, Experimentation, Start-up and Spin-off.

Fig. 1 Representation of the usage of the non-assisted interface.

Fig. 2 Representation of the usage of the assisted interface.

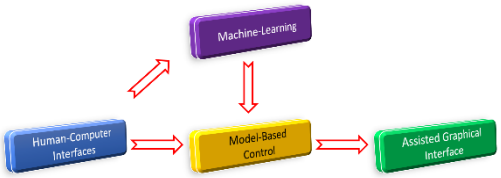

Fig. 3 Representation of the workflow behind the invention.

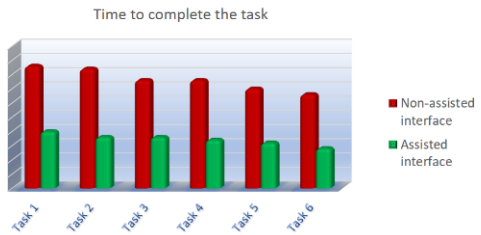

Fig. 4 Benefits measured in terms of the time required to complete the task, when using the assiste interface in place of the non-assisted one.

Abstract

The invention proposes an innovative solution for choosing a command in a graphical interface.
The considered solution has been developed with the specific aim of offering assistance to a patient who is attempting to move a cursor on a graphical interface, in such a way as to enrich the currently available human-computer interfaces with improved functionality that is useful for patients suffering from neurodegenerative diseases, or from lesions to the first or second motor neuron, affected by paralysis or paresis. In fact, this will allow the patient to autonomously perform common daily actions such as turning the lights on, regulating the temperature in the room, etc.

Publications

- M.A. Velasco, R. Raya, L. Muzzioli, D. Morelli, M. Iosa, F. Cincotti, E. Rocon, "Evaluation of cervical posture improvement of children with cerebral palsy after physical therapy with a HCI based on head movements and serious videogames," Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics), 9656, pp. 495-504, 2016.
- R. Raya, R. Ceres, E. Rocon, J.L. Pons, "Empowering the autonomy of children with cognitive and physical impairments by inertial head tracking," Procedia Chemistry, 1 (1), pp. 726-729, 2009.

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Technical Description

The proposed solution allows disabled users to move the cursor of a graphical interface in a comfortable and successful way. Due to the disease, the trajectories drawn by the cursor, in the absence of an assistive solution, are not regular and this makes the use of the graphical interface difficult. For this reason, the patented solution is characterized by two innovative aspects: its support action is based on a personalization process and is designed so as to be predictive, i.e., it is based on the prediction of the target desired by the user while the user himself moves the cursor.
In other words, thanks to machine learning and automatic control methods, the proposed solution foresees which action the patient is going to take and assists him while selecting items in the graphical interface, thus requiring as little effort as possible.

Technologies & Advantages

A high level of interest in solutions that are comparable to the current one has emerged at European level (e.g., see the FP7 ABC project, the Spanish InterAAC project and the Italian BrindiSys project), and in the United States a number of similar inventions have been patented, also in complementarity with the usage of exoskeletons. Yet, none of the already existing solutions deals with the assistance to patients suffering from motor disabilities (i) in a personalized fashion, based on innovative machine learning techniques, (ii) resorting to an automatic control scheme, based on model predictive control and thus capable of providing a predictive support action, and (iii) yielding the same degree of portability. Indeed, the proposed solution can be integrated in the software of several devices behaving as human-computer interfaces.

Applications

This invention can prove useful in the context of home automation in case of people with motor disabilities using human-machine interfaces, for example to monitor and control the lights or to close/open the door lock.

Patients are assumed to interact with a processing unit by means of a graphical interface and to move the cursor towards some specific targets on a screen by relying on several possible hardware devices: e.g. in the case of a patient suffering from paresis, the system can use an inertial platform fixed to the head of the patient herself/himself to collect data on his inclination and movement; in the case of a patient suffering from complete paralysis, the system can be interfaced with sensors that are capable of detecting eye movements.

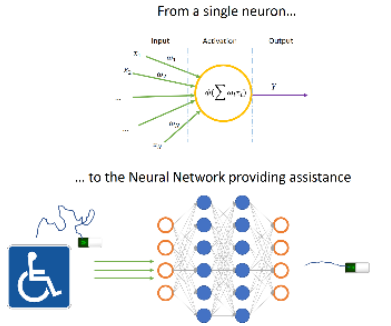

Fig. 5 Training of a Neural Network for identifying the reference trajectory.

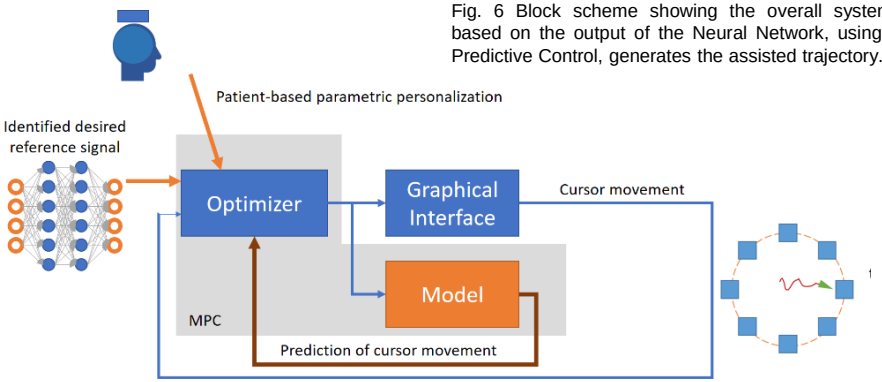

Fig. 6 Block scheme showing the overall system that, based on the output of the Neural Network, using Model Predictive Control, generates the assisted trajectory.

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