Adaptive assistive technologies for people with disabilities

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"Assistive technologies" (AT) have developed rapidly in recent years, allowing people with motor disabilities to live more independent and comfortable lives. Now assistive technology systems that can open a door, turn on a light or connect to the internet at the blink of an eye, a head movement or even a thought, are being made more flexible and customisable for individual users - thanks to the work of EU-funded researchers.

An estimated 2.6 million people in Europe have mobility problems affecting their upper limbs, and around 1.3 million of them require assistive technologies, or the help of human carers, to be able to perform everyday tasks. Across developed countries, the figure rises to 2.5 million. They include people suffering from a range of diseases, including multiple sclerosis and amyotrophic lateral sclerosis, as well as varying degrees of paralysis, among them locked-in syndrome in which a person may only be able to move their eyes.

While many people already make use of assistive technologies -an umbrella term that includes assistive, adaptive and rehabilitative devices for people with disabilities -in most cases the systems and applications are designed to perform one specific function or assist someone with a specific form of disability.

"What I would call the "old" AT-market is dominated by isolated applications and devices, each addressing a specific disability or focusing on a specific ability of the user. This is in principle good, since

it means that each device can be brilliantly optimised in its functionality," explains Stefan Parker, a project coordinator and researcher at KI-I in Austria. "The trouble is that in most actual use cases these devices only manage to take advantage of a part of the user"s abilities or, in other cases, are not properly adaptable to the user"s needs, leaving him or her with a device that is merely semi-optimal for their use case."

The problem is that disabilities cannot be categorised. Every person is different and even two people suffering from the same disease will often have very different degrees and types of impairment, or a combination of different disabilities at the same time. And an individual sufferer will usually need systems to be adjusted, or new devices to be used, as their symptoms evolveover time.

In order to address the issue, a consortium of research institutes, universities and private companies from seven countries have developed an affordable and scalable platform to implement AT in a much more personalised and flexible way. Their system, developed over two years in the "Assistive technology rapid integration and construction set" (ASTERICS) project with the support of EUR 2.65 million in funding from the European Commission, has already gone into commercial production.And on-going research is set to enhance it further.

Assistive systems, centred on the user

"The AT market is currently subject to great change. On the one hand, mobile devices like smart phones and tablet PCs are conquering the world, and this has a great influence on the AT market. On the other hand, more user-centred and more flexible approaches towards AT are being generated - ASTERICSbeing the first and therefore most important,"says Mr Parker, who helped coordinate the project.

Unlike traditional AT systems, the ASTERICSplatform can be configured to meet the specific needs of individual users. It is possible to choose from a wide variety of sensors, from simple switches or webcams to advanced "brain-computer interfaces" (BCI), for interaction with the system depending on the requirements and abilities of each person.

The input data, no matter how it is generated, is processed by the "ASTERICSRuntime Environment" (ARE). The software can easily be installed on a Windows-based machine and uses so-called "models", configured for each user, to process and execute user commands on any device in order to use their smart phone or computer,and to control their air conditioning or open a window in their home.

The models are built and configured via a dedicated configuration programme, the "ASTERICSConfiguration Suite" (ACS) in which, through a graphical interface, it is possible to combine several plug-ins for input, signal processing and output and connect them via data-channels and event-channels. Once completed, a model is simply uploaded to the ARE, where several models can be stored, so the user can have different options for different use cases.

There are also extension modules for the connection of sensors, which can be connected either to the platform or to any other computer via a standard USB cable, along with a HID actuator - a small USB-interface that acts like a standard wireless plug-and-play device, emulating mouse, keyboard or joystick.

"The approach results in a completely user-centred on-site development of AT - the user no longer needs to adapt to the device, it"s the other way round. This goes so far that users can even make small adaptations themselves, or their carer can make them for them, to react to changes in the daily situation," Mr Parker notes. "Also the system can be adapted every time a user"s condition changes for better or worse - usersno

longer need to buy a new device every time their condition changes - or use the old one despite having a hard time doing so - they can continue to use the system they are accustomed to and like, but with a new means of input or just with refined settings."

People suffering from motor disabilities, as well as specialised carers and AT experts, were consulted by the ASTERICSteam throughout the design and development process, and prototype platforms received overwhelmingly positive feedback in trials.

"ASTERICSwas really appreciated by users and during the course of the user tests we were able to give possibilities to people that they wouldn"t have had without the system. Some users have continued to use the ASTERICSsystem since the user tests and are very happy with it," Mr Parker says.

Crucially, the system is relatively cheap to install, and can make use of users" existing devices, such as the webcam on their laptop, to reduce costs further. Mr Parker estimates that most people would need to spend around EUR 500, excluding the cost of buying a laptop or home PC, for a suitable set up, though it could run to several thousand euro if more expensive equipment such as a brain-computer interface is required.

IMA, a project partner based in the Czech Republic, is currently producing commercial hardware, including input/output modules for use with the system, while Harpo in Poland, another partner, is the prime distributor of the complete system and provides adaptation and customisation services.

The team"s goal now is to continue their research and launch a follow-up project to extendthe system to mobile devices such as smart phones and tablets.