Transforming Internet Access for People with Disabilities

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In the digital era, where Zoom, email, and social media platforms prevail, communication has never been easier. For some of us, even if we are in different parts of the world, daily communication is no longer an issue. Unfortunately, for individuals with disabilities, this is not always the case. A team of local researchers is exploring ways to facilitate access to the internet and all that it affords, including communication, work, and entertainment.

Dr Chris Porter

For individuals with vision or hearing impairments, communication can be a challenge. While various assistive technologies such as screen readers and artificial intelligence-based tools have been developed to overcome these challenges, there is still room for improvement. Furthermore, there are other situations that can make communication even more challenging, and this is the case for people with severe motor impairments, including locked-in individuals.

In a nutshell, this rare condition results in complete paralysis, where all voluntary muscles except those controlling eye movements cease to function. Despite their immobility, these individuals remain conscious and able to understand their surroundings. They can remember, imagine, perceive, and process information, but they lack voluntary speech and bodily expressions.

'How are you supposed to live when your body can perceive but can no longer respond? How would people know inside the immobile body you are still alive?' writes Jean-Dominique Bauby in his memoir, *The Diving Bell and the Butterfly*.

On 5 December 1995, Jean-Dominique Bauby, then editor of the French magazine *Elle*, suffered a massive stroke that left him quadriplegic and mute. In his memoir, Bauby shared his experience of loneliness and powerlessness as a locked-in individual. He communicated by blinking his left eyelid to select letters and form words, sentences, and a narrative, one blink at a time.

ENHANCING INTERNET ACCESSIBILITY WITH CACTUS

Reading Bauby's memoir inspired Dr Chris Porter, a researcher and senior lecturer at the Faculty of ICT, UM. Bauby's story illuminated the challenges faced by locked-in individuals and their need for enhanced communication. Porter embarked on his work in assistive technology to explore how technology could assist people living with such conditions.

'We are currently developing two different projects that address accessibility for people with severe motor impairments,' explains the researcher. The first project, named CACTUS, involves the development of a novel web browser that is designed to be primarily operated via eye-tracking devices. This technology detects a person's presence and tracks their gaze in real time, providing unrestricted access to the internet. With this technology, users can perform various online tasks, from sending emails to browsing and shopping.

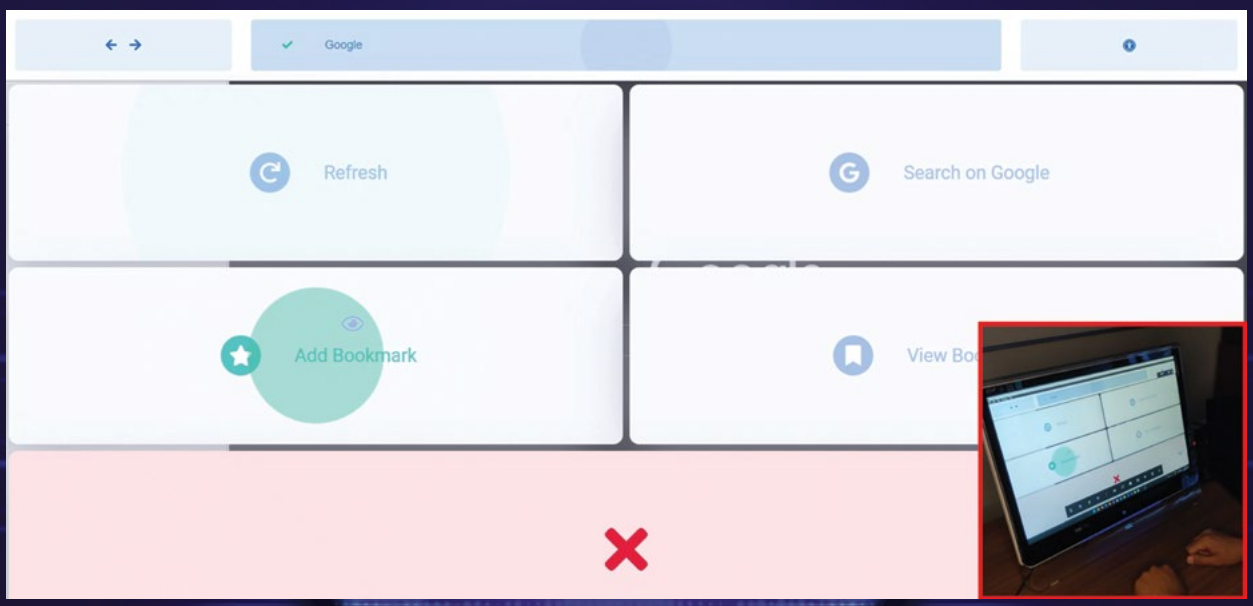
'The idea is to enable people to browse as efficiently as possible, depending on their capabilities, even if they cannot use a mouse, keyboard, touch screen, or even their voice,' Porter elaborates. They are also creating a multimodal approach, allowing people with some residual motor function to use alternative devices, such as adaptive switches, to

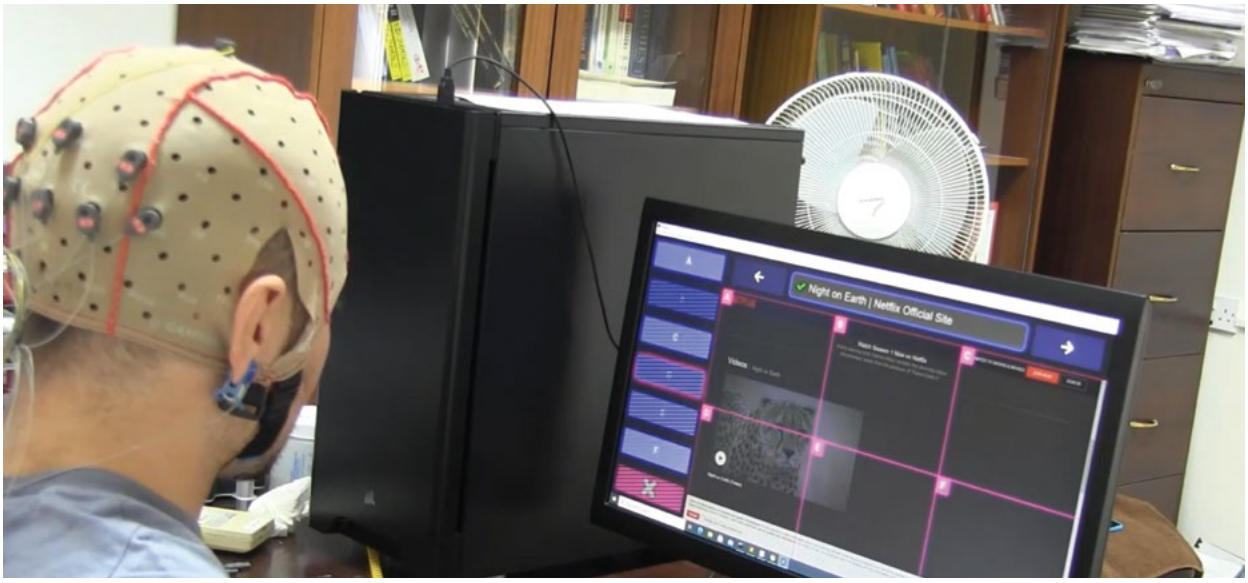
Top: HCI Lab within the Faculty of ICT, University of Malta

Centre: CACTUS browser – a user accessing common browser functionality

Bottom: CACTUS browser –a user interacting with a navigation region on a website

Images courtesy of Dr Chris Porter





BOGGLE browser – a user selecting a link on a page
Photo by Alison Camilleri

expedite the process. For example, if an individual has some hand movement, a custom switch can be adopted for quicker selections.

THE POTENTIAL BOGGLES THE MIND

While CACTUS addresses the needs of individuals who can use eye trackers, there are others who cannot. Porter's second project, BOGGLE, targets these individuals with distinct needs by using brain signals. This project is being carried out in collaboration with Dr Tracey Camilleri, a senior lecturer with the Department of Systems & Control Engineering at the Faculty of Engineering, UM.

'We are focusing our attention on brain-computer interaction (BCI) based on Steady State Visually Evoked Potentials. When you focus your attention on a visual stimulus, such as a button flickering at a specific frequency, a portion of your brain responds to it in a predictable manner. This is a well-known neuronal response, which we can capture and interpret to determine the person's intentions,' Porter explains. By measuring brain activity, the BCI browser can recognise which command the individual is looking at and wants to activate.

Despite being in an early stage, the researchers have observed encouraging results from a recent study. Participants were able to access the internet and carry out a number of common tasks, including searching and watching videos. Although brain-computer interaction is typically slow, BOGGLE offers significant improvements in terms of browsing freedom, classification accuracy, and speed over existing technologies.

'Assistive technologies can be incredibly expensive. Even with best-of-breed assistive technologies, they can't be of much help if they're not affordable,' Porter emphasises. The team at UM is working to minimise barriers to entry by building their own assistive technologies using low-cost hardware while also open sourcing code for others to use and build upon.

'This kind of technology can be frustrating, but it can also be life-changing. We're ensuring that people with severe motor disabilities can harness the power of technology to live better, fuller lives,' Porter concludes.

In a world where communication is increasingly digital, these remarkable innovations are breaking down barriers for individuals with disabilities. As CACTUS and BOGGLE pave the way for enhanced accessibility and independence, they signify the unyielding human spirit and determination to harness technology for the betterment of all. With open-source solutions and a commitment to affordability, the UM's research team is lighting the path towards a brighter, more inclusive future, where technology serves as a bridge, not a barrier, to a life well-lived.

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