Fuzzy Logic Based Web Browser for the Motor Impaired

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Paralyzed or paretic individuals lack the ability to move their limbs and may be speech impaired. They cannot use traditional human-computer interaction methods to harness the power of web-based communication, education, and entertainment opportunities. The goal of this project is to develop a specially designed, low-cost web-browsing system that improves the quality of life of these individuals. Individuals use vision to scan a webpage in this system, just as they would with a conventional browser. However, instead of touch screen, keyboard, or voice recognition input, this system uses an innovative integration of eye- and brain-control for relaying and interpreting navigation commands. One component of this project was to develop an image processing algorithm which tracks a user's gaze with OpenCV in C++. The system integrates gaze position estimates with brain concentration levels sensed and transmitted by an electroencephalogram headset. Since the image processing can be imprecise and user intent itself may be uncertain, the system uses a novel fuzzy logic algorithm for combining brainwave and eye position inputs to determine the user's intended hyperlink. This algorithm uses exponential smoothing to keep track of previously recorded signals and is implemented on an iPad in Objective-C. Testing on a sample of 31 individuals with six observations per individual established that the first attempt success rate lies between 87% and 95% with 95% confidence. Error recovery accuracy was 98.4%, resulting in a second attempt success rate of 99.1%. This assistive communicative system, using off-the-shelf components, costs less than $100, excluding the iPad. This technology has the potential to affordably open up the Internet to millions of disabled individuals.

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