A Novel Single Channel Electroencephalogram-Eye Tracking Based Computer Interface System

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Numerous attempts have been made to develop standalone electroencephalogram (EEG) and eye tracking based human computer interface (HCI) systems, but the success of such systems when used independently has been limited due to an inability to noninvasively extract data from users, a reliance on invasive head-pieces and complex algorithms, constrained head motion, high cost, and inconsistent accuracy. The purpose of this research was to design a novel, hybrid HCI that combines the benefits of EEG and eye tracking-based systems into a single, affordable, efficient and easy to use HCI device. Eye tracking was achieved by implementing a low computational complexity algorithm developed by Timm and Barth (2011) that uses a single webcam input and image gradients to compute dot products between normalized displacement vectors and gradient vectors, while a single channel EEG device was utilized as a selection mechanism. The eye tracking system performed with 90% accuracy using a low resolution camera at 15 frames per second to produce continuous, fluid cursor motion, and the EEG selection mechanism consistently converted user eye blinks into mouse selection events. Consequently, this novel hybrid design shows potential for incorporation into a wide variety of applications including assistive technologies, wearable electronics and virtual reality.

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