Gaze Link: A Multi-language Low-Cost Mobile Eye-Gesture Communication System With Large Language Models for People With Amyotrophic Lateral Sclerosis

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People with Amyotrophic Lateral Sclerosis (PALS), who have severe motor and speech impairments, mostly rely on their eyes and assistive technology to communicate. However, existing high-tech products are expensive and hard to access, while low-tech products are inefficient and restrictive. To mitigate the limitations, this research proposes GazeLink, a low-cost mobile application for PALS to communicate efficiently with only eye movements. First, the system recognizes user eye gestures like left or up with machine learning and a template-matching algorithm. Then, it converts the eye gestures to words through a keyboard that supports English, Spanish, and Chinese. For efficiency, the system employs Large Language Models (LLMs) to generate a suitable sentence with words typed by the user and the context. Finally, the system provides text-to-speech and social media post services for both verbal and digital eye-gesture communication. Simulations conclude that sentence generation with LLMs can improve text-entry rate by 81% while maintaining 90% of semantic similarity. Usability studies with 30 participants show that GazeLink can recognize eye gestures with 94.1% accuracy in varying lighting. After rapidly learning the user interface in under 10 attempts, first-time participants typed sentences of various lengths with their eyes at 15.1 words per minute, which is 7.2x faster than the common low-tech solution E-Tran. Experiments demonstrate GazeLink's efficiency, learnability, and accuracy in eye-gesture text entry. The system is extremely affordable (<$0.1 a month), portable, and easily accessible online. It also supports different users, lighting, smartphones, and languages. Product testing with PALS and personalized LLM models will be the next step.

Awards Won:
Second Award of $2,000
Association for the Advancement of Artificial Intelligence: AAAI Student Memberships for each finalist that is part of the 1st, 2nd, and 3rd Prize Winning projects and 5 Honorable Mention winning projects (up to 3 students per project) (in-kind award / part of the 1st-3rd prize)
Association for the Advancement of Artificial Intelligence: AAAI Membership for the School Libraries of All 8 Winners (in-kind award / part of 1st-3rd prize and honorable mentions' prize)
Association for the Advancement of Artificial Intelligence: Second Award of $1,000
IEEE Foundation: Third Place Award of $400