LiberaNex : A Novel Brain-Computer Interface Utilizing EEG and Eye-Tracking for Assistive Communication and Device Controlling

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Communication and mobility disabilities, especially those caused by conditions such as Locked-in Syndrome (LIS) or limb amputees, pose serious challenges that prevent individuals from expressing their thoughts and needs. The psychological impact of such conditions is often severe, leading to depression and helplessness. This project introduces an innovative Brain-Computer Interface (BCI) system that integrates Electroencephalography (EEG) and Eye Gaze Tracking (EGT) to provide an effective communication method for individuals with physical and communication disabilities. The system was designed using a human-centered approach, ensuring that the interface prioritizes comfort, privacy, and cultural accessibility. Special attention was given to developing interfaces that are intuitive and optimized for ease of use, achieving high user satisfaction. After testing, the system successfully enabled real-time communication, allowing users to browse the Internet, send messages, and perform essential digital tasks. These results demonstrate the system's potential to reduce psychological burdens and improve users' autonomy. The project contributes to seven Sustainable Development Goals (SDGs), emphasizing both its technological innovation and social impact. By addressing key challenges in assistive technology, this project opens new possibilities in the BCI field and shows how advanced systems can transform lives. Its adaptability and scalability make it suitable for users with diverse needs. This project not only delivers a promising tool for communication but also marks a step forward in inclusive technology that promotes independence and improves life quality for individuals with severe disabilities.

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