

Abstract: Wearable Brain Device with EEG Monitoring System for A Narrative-based Cognitive Stimulation Program (NCSP) “A Trip of Memory”

Theme: Improving Practice through Digital Technologies

Authors

Armstrong Tat San CHIU¹, Hin-Chung LAU², Tsz Sun NG², Nok Man HO², King Yeung TAM², Chun Yu WONG², Ming Chung MA², Samel CHIEN⁵, Ka Keung WONG³, & Wing Sze WONG⁴

¹ Residential Services, The Hong Kong Society for the Blind, HKSAR, China

² Department of Biomedical Engineering, The Hong Kong Polytechnic University, HKSAR, China

³ Department of Rehabilitation Sciences, Faculty of Health and Social Sciences, The Hong Kong Polytechnic University, HKSAR, China

⁴ Department of Chinese and Bilingual Studies, Faculty of Humanities, The Hong Kong Polytechnic University, HKSAR, China

⁵ Hong Kong College of Health Service Executives, HKSAR, China

Background

Cognitive impairment, particularly in aging populations, necessitates innovative rehabilitation strategies that combine objective assessment with engaging interventions. This project, titled “*A Trip of Memory*” *Cognitive Training*, introduces an integrated EEG monitoring system designed to enhance cognitive rehabilitation through reminiscent memory stimulation, such as storytelling. By leveraging Montreal Cognitive Assessment (MoCA) frameworks and real-time electroencephalography (EEG) data, the system aims to strengthen neural connections, improve patient engagement, and provide quantitative evaluations of cognitive progress.

Methology and Device

The system addresses critical end-user needs, including minimizing human intervention in monitoring, reducing subjectivity in observations, and offering adaptive, personalized activities. Central to its design is the fusion of hardware and software technologies. The Neeuro SenzeBand 2 EEG headset captures brainwave data to assess mental states during activities, while RFID sensors track interactive elements, such as card-based tasks, to measure participation. A Unity-based interface facilitates cross-platform accessibility and integrates an adaptive activity library, enabling facilitators to customize sessions. AI-generated videos and curated artwork enhance visual engagement, while a speaking time tracker quantifies verbal interaction

through audio thresholds.

Methodologically, the system combines neuroscientific data collection with interactive feedback loops. EEG metrics, RFID interactions, and speech duration are synchronized to evaluate attention, memory retention, and engagement. Data is exported as CSV files for section-based mental state averaging, enabling longitudinal analysis of cognitive trends. This multimodal approach ensures objective, data-driven assessments, contrasting traditional subjective evaluations.

Result

Preliminary results demonstrate the system's capability to generate actionable insights through raw EEG data, labeled interactions, and composite metrics. The adaptive library's flexibility allows dynamic adjustments to activity difficulty, maximizing patient involvement. By automating data collection and analysis, the system reduces reliance on manual observation, enhancing scalability in clinical or community settings.

In conclusion, this project presents a novel integration of EEG technology, IoT sensors, and adaptive software to advance cognitive rehabilitation. Its emphasis on quantitative metrics and personalized engagement offers a replicable model for cognitive health initiatives. Future work includes clinical validation trials and expansion of the activity library to address diverse cognitive deficits. Developed in collaboration with Hong Kong Sheng Kung Hui Welfare Council and The Hong Kong Polytechnic University, this innovation bridges resource gaps in community-based cognitive care, fostering inclusive, evidence-driven rehabilitation solutions.

Keywords: EEG, Cognitive Rehabilitation, Adaptive Interface, RFID, Quantitative Assessment.