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소프트 바이오일렉트로닉스와 마이크로-브레인 센서를 활용한 지속 가능한 뇌-컴퓨터 인터페이스와 일상생활의 변화

Transforming Daily Life with Persistent Brain-Computer Interfaces Using Soft Bioelectronics and Micro-Brain Sensors

Abstract:

Brain-computer interfaces (BCIs) have traditionally been constrained by hardware limitations and signal instability, restricting their long-term application in healthcare and daily life. To overcome these challenges, we propose a persistent BCI framework that integrates soft bioelectronics and micro-brain sensors, enabling stable and long-term neural signal acquisition while minimizing motion artifacts. This system leverages multifunctional soft materials to enhance user comfort without compromising signal fidelity. Building on this persistent BCI framework, we explore its applicability across various domains. We demonstrate its potential for neural interface control, physiological state monitoring, and cognitive and emotional state recognition to enable personalized adaptive environments. By examining these diverse applications, we highlight how persistent BCI technology can be seamlessly integrated into both medical and everyday settings. This study presents the transformative potential of persistent BCI technology in shaping the future of healthcare and daily interactions, bridging advances in materials science and signal processing to pave the way for next-generation neuroadaptive systems.

Brief Biosketch

Hodam Kim received his B.S. degree in Biomedical Engineering from Hanyang University in 2015 and his Ph.D. degree in Electronic Engineering from Hanyang University in 2022. He was a Postdoctoral Fellow at the George W. Woodruff School of Mechanical Engineering, Georgia Institute of Technology, Atlanta, GA, USA, from 2022 to 2024, and at the Biomedical Engineering and Imaging Institute & Department of Radiology, Icahn School of Medicine at Mount Sinai, New York, NY, USA, from 2024 to 2025. Since 2025, he has been an Assistant Professor in the Division of Biomedical Engineering at Yonsei University (Mirae Campus), Wonju, Republic of Korea.His research interests include brain-computer interfaces (BCIs), human-computer interfaces (HCIs), soft and wearable electronics, and biomedical signal processing algorithms.