Integration of AI and Biochemical Signals

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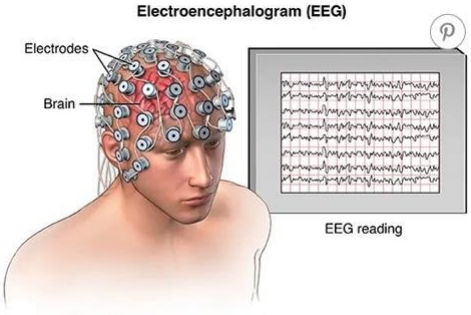
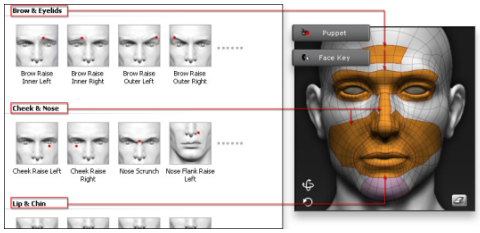
Biochemical Signals

Electroencephalography (EEG)



https://www.brightbraincentre.co.uk/wp-content/uploads/2021/05/The-measurement-and-display-of-EEG-on-human-brains-with-electrodes-8.jpg

Facial Muscle Movement



https://www.reallusion.com/iclone/help/3dxchange5/Images/Setting_Face_Muscles_00.jpg

Brain Computer Interface

- What is BCI?

  Utilize AI to analyze users' biochemical signals such as EEG signals and transform them into control signals for operating external devices

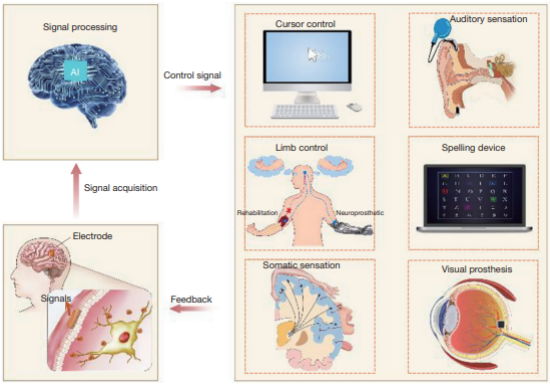
- Application?

  Cursor control machine

  Somatosensation

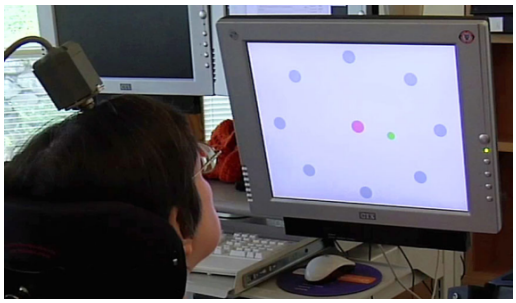
  Auditory sensation

  Cognition Enhancement



Brain Computer Interface

Cursor Control Machine



https://news.brown.edu/files/images/BrainGate2.jpg

Hawking's Wheelchair

https://www.theweek.in/content/dam/week/news/sci-tech/images/2018/4/1/hawking-file-afp.jpg.transform/schema-4x3/image.jpg

AI in Brian Computer Interface

- Natural language processing:

  Increasing user experience

- Machine/Deep Learning Algorithms & Neuron Networks:

  Increasing interpretability

  More accuracy in converting bio-signals to control signals

  Higher efficiency

Cursor Control Machine

- Pioneer one dimension Control:

  EEG, Event-related desynchronization (ERD), Decision trees

- Two dimensional Control:

  Functional Magnetic Resonance Imaging (fMRI) and EEG

- Potential Combination for higher dimension:

  ReFIT Kalman Filter and Hidden Markov Model-based state classifier

Real-Time Monitoring and Interaction

Real-Time Monitoring in Medical Environments

- In critical areas like the Intensive Care Unit (ICU), AI-enhanced BCIs utilize EEG data to continuously monitor patients' neurological states.
- Predicts and responds promptly to sudden neurological events such as epileptic seizures, reducing long-term neurological damage and saving lives.

Advances in AI for Natural Interactions

- Employs advanced neural networks to learn from the user's habitual neural patterns, making the interface more responsive and easier to use over time.
- Predicts user needs and enhances the responsiveness and accuracy of assistive technologies.

Case Study: Emergency Stroke Response

- System automatically alerts medical personnel and provides critical data to guide immediate treatment decisions.

Stephen Hawking's Assistive Technology

Overview:

- Combination of infrared switches, a cheek-operated joystick, and evolving BCI technologies.
- Use AI to optimizing interface responsiveness to Hawking's limited motor capabilities.
- Utilized NLP algorithms for predictive text generation, adapting to Hawking's speech patterns and preferences over time.

Future:

- Continuous development to enhance communication efficiency and ease for users with severe physical limitations.

Impact:

- Continued career in physics, public speaking, writing, and personal communications.
- Demonstrated profound capabilities of AI in translating minimal physical movements into extensive communication functions.

Challenges

Ethical:

- Privacy and Consent
- Autonomy and Manipulation
- Accessibility and Inequality

Technical:

- Reliability and Safety
- Security Concerns
- Broader Societal Implications

Reference

- https://medium.com/dataduniya/ai-and-brain-computer-interfaces-connecting-minds-and-machines-c8e8ad04f683#:~:text=The%20integration%20of%20artificial%20intelligence,human%20mind%20and%20external%20devices
- The combination of brain-computer interfaces and artificial intelligence: applications and challenges - PMC (nih.gov)