

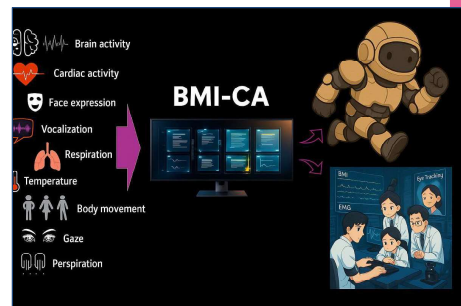


# Development of a New Interface for Cybernetic Avatar (CA) Operation ~ A Platform for Integrating Multi-modal Information

Kan Akutsu Team Leader, ARAYA Inc.

## Overview

Brain-Machine Interfaces (BMIs), which connect the brain to external devices, are anticipated to be used as interfaces for operating Cybernetic Avatars (CAs). However, an optimal interface that is accessible to everyone does not yet exist. This research aims to identify the optimal interface for CA operation by integrating and combining multiple types of sensory information, such as EEG (brainwaves) and EMG (muscle signals), with a view toward practical implementation in society. Handling different types of biological data like EEG and EMG together is challenging, and no general-purpose solution existed. Therefore, we built a "BMI-CA Platform" that standardizes multiple bio-signals and can be operated entirely via a GUI, enabling even non-experts to develop interfaces for avatar operation.



## The BMI-CA Platform

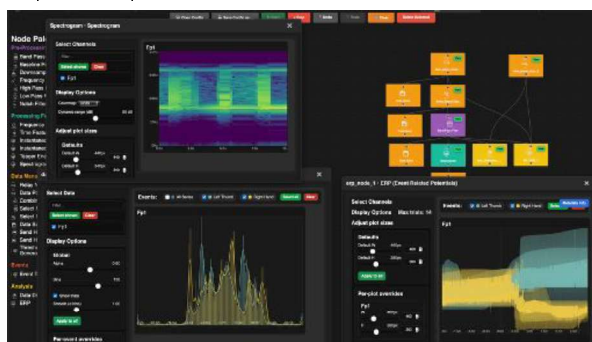
The BMI-CA Platform is software that enables easy, synchronized acquisition of diverse bio-signals (e.g., EEG, EMG), along with real-time analysis and visualization. It provides a flexible multi-modal analysis environment for researchers and an intuitive operational experience for general users, targeting a wide range of applications from medicine and education to entertainment.

### Features

- ✓ **Diverse Signal Processing:** Synchronized acquisition, real-time analysis, and visualization of EEG, EMG, and eye-tracking data.
- ✓ **User-Adaptive Flexibility:** Simple GUI blocks for users unfamiliar with programming, alongside advanced customization options for experts.
- ✓ **Device-Agnostic Standardization:** Improves development efficiency by standardizing data formats and calibration methods across different sensors.
- ✓ **Command Conversion:** Easily translates analysis results into control commands for virtual environments or physical robots.
- ✓ **Cross-Platform Support:** Docker-based system compatible with Linux, Windows, and Mac, simplifying environment setup.

### Future Outlook

We plan to make this platform open-source, further enhancing support for commercial sensors, real-time processing, and machine learning integration. Our future goal is to develop this into a "BMI infrastructure accessible to everyone, like the internet," accelerating global joint research, industrial applications, and the real-world deployment of new operational experiences.



BMI-CA Platform analysis screen

### Future Prospects

By developing a platform capable of integrating multiple modalities, we have successfully lowered the barrier for multi-modal analysis and application development. We will continue to update the platform to integrate the various core technologies created within the IoB project. We will also expand its practical use cases—from research to application development in various fields and education—and evolve the platform by incorporating user feedback to ensure it becomes a vital tool for society used by many.

## Various Use Cases

### Industry

The platform can be applied as a next-generation controller for operating robots or game characters by integrating multiple bio-signals. It is expected to support a wide range of targets, from small robots to large construction machinery, enabling intuitive control that naturally reflects the user's intent. Furthermore, as a common infrastructure for BMI-based application development, it is expected to be used in entertainment, such as for controlling new game characters.

### Healthcare

The platform is expected to serve as a foundation for continuously monitoring health status, concentration levels, and stress by visualizing brain activity and physical conditions in real-time. This not only supports daily self-care and performance management but can also be utilized as an auxiliary interface in rehabilitation and welfare, holding promise for applications in the medical and welfare fields.

## Joint Research with Dubai Future Labs

The "Internet of Brains" (IoB) project, in collaboration with Dubai Future Labs (DFL) operated by the Dubai Future Foundation (DFF), has initiated joint R&D on next-generation BMI technology. This technology will allow people to freely control robots and avatars using their own EEG (electrical signals from the brain) and EMG (electrical signals from muscles).



Site visit in Japan, May 2025

Our partnership with DFL is a strategic move to dramatically accelerate the real-world implementation of our advanced technology. DFL, with strong support from the Dubai government, is one of the world's leading organizations in rapidly promoting the demonstration and societal implementation of future technologies, utilizing the entire city as a "Living Lab." Dubai's diverse environment, where people from over 200 nationalities coexist, provides an unparalleled and ideal testbed for verifying the global acceptance of our technology. Through this partnership, we aim to go beyond technological development to validate social and cultural acceptance, deploying truly valuable research outcomes to the world.

### Kan Akutsu

Team Leader, MultiSense Foundation, ARAYA Inc.

After completing his Master's degree at the Graduate School of Information Science and Technology at the University of Tokyo in 2012, Kan Akutsu joined DeNA Co., Ltd., where he developed and planned multiple IP-based titles. He later joined ZEALS Co., Ltd. as a Product Owner, engaging in the development of general-purpose conversational robots. Currently, as the Team Leader of the MultiSense Foundation at ARAYA Inc., he serves as a Principal Investigator (PI) under Project Manager (PM) Kanai in the IoB project, advancing research on a common infrastructure for avatar operation using multi-modal bio-signals, including brain information.

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Internet of Brains