Goal 3 Realization of AI robots that autonomously learn, adapt to their environment, evolve in intelligence and act alongside human beings, by 2050.

Here begins our new MIRAI

MOONSHOT RESEARCH & DEVELOPMENT PROGRAM

Next-Generation Humanoid AI Robots through Whole-Body Tactile Intelligence

Project manager

(selected in 2026)

IIDA Fumiya

Professor, Graduate School of Engineering, The University of Tokyo



Leader's institution

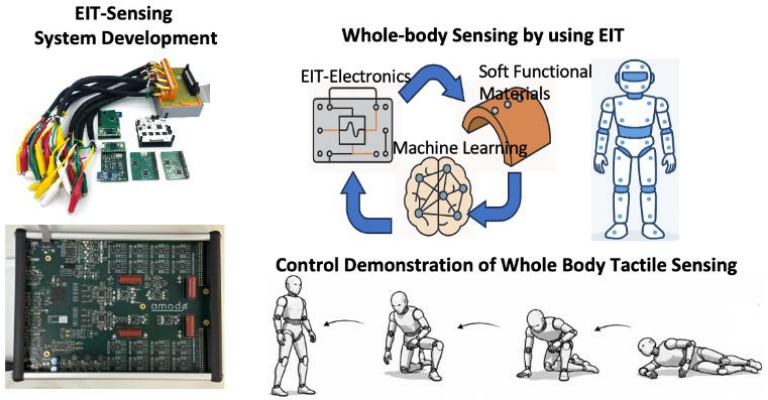
The University of Tokyo

R&D institutions

The University of Tokyo

Summary of the project

This project aims to achieve a fundamental advancement in general-purpose autonomous humanoid AI robots by establishing core technologies centered on whole-body tactile sensing using electrical impedance tomography (EIT) and overcoming limitations in conventional robotic body structures. Next-generation EIT-based tactile sensors offering wide-area coverage, high spatial density, and high sensitivity will be integrated across the entire body of a humanoid AI robot using flexible functional materials. By processing vast amounts of tactile data in real time through attention mechanisms, the project will develop a new model of embodied intelligence that enables the robot to sense, act, understand, and adapt using its entire body.



Milestone by 2028

We will establish the core technologies for soft tactile sensors that offer the flexibility, stretchability, and durability required for whole-body integration. We will also develop a humanoid robot prototype that integrates the sensors, body mechanisms, signal processing, and AI, and demonstrate posture stabilization, adaptation to physical contact, and the learning of fundamental movements using whole-body contact information.

Project structure

This project will advance the following research and development activities through close collaboration:

- Soft tactile sensor development
- Whole-body sensor integration
- Tactile sensing and motion control
- Real-time body–environment interaction
- Humanoid robot implementation and demonstration

Fumiya Iida (PI): Department of Precision Engineering, Graduate School of Engineering, The University of Tokyo



Professor Iida will develop EIT-based, large-scale tactile sensing and an integrated process for designing, fabricating, and embedding flexible sensors throughout humanoid robots. He will also establish tactile-driven frameworks for real-time environmental recognition and motion learning and control, while advancing practical applications and the supporting research environment.

Tomoyuki Yokota (PI): Institute of Engineering Innovation, Graduate School of Engineering, The University of Tokyo



Professor Yokota will develop conductive, flexible, stretchable, and durable materials for whole-body tactile sensors. By optimizing their composition, microstructure, and fabrication, he will enable stable performance under repeated deformation and establish materials for wide-area, high-sensitivity EIT sensing.

*Certain illustrations in this document were created with the assistance of generative AI.

Japan Science and Technology Agency