Integrated Research and Development of Humanoids Capable of Operating in Challenging Environments

Project manager

(selected in 2026)

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Leader's institution
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R&D institutions
The University of Osaka, Chubu University, Kanazawa University, Kagawa University, Nagoya University, Hokkaido University, Toyohashi University of Technology, University of Fukui, Nara Institute of Science and Technology, Kawada Technologies, Inc.

Summary of the project

This research aims to realize a humanoid robot capable of performing real physical work in unstructured and challenging environments such as construction sites. Its novelty lies in the integrated development of: (i) lightweight, high-power, and highly durable hardware; (ii) locomotion and whole-body motion planning that fuses model-based control with learning; (iii) manipulation skill acquisition that structures and extends the tacit knowledge of skilled workers; and (iv) human–humanoid and multi-robot collaborative intelligence enabled by multimodal AI. Using actual construction and manufacturing sites as demonstration fields, we will verify the system in a stepwise manner. We will establish the core technological foundation required for practical deployment at limited work sites by 2030 and for the realization of general-purpose autonomous humanoid AI robots by 2050. This project will make a significant contribution to resolving the increasingly severe labor shortage and to achieving safe and sustainable on-site operations.



Milestone by 2030

(1) Enable the developed humanoid to perform load-slinging, test-piece retrieval, and maintenance and inspection tasks.

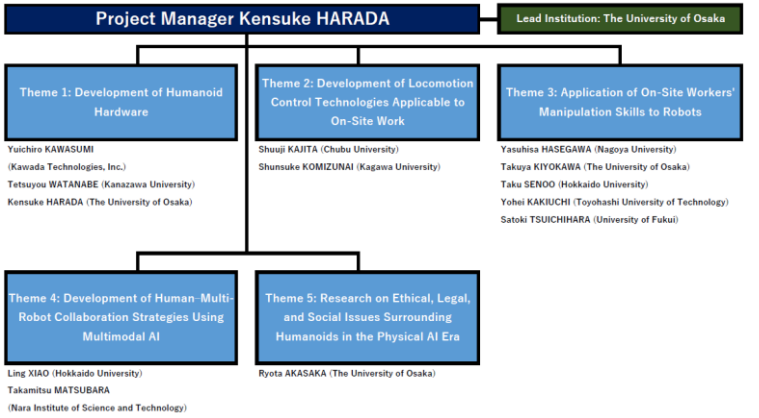
(2) Enable the developed humanoid to move autonomously over narrow scaffolds and stairs, using handrails.

(3) Achieve load-slinging work with an efficiency comparable to that of a human by observing the operations of skilled workers, directly estimating their end-effector impedance characteristics, and reproducing these characteristics on the robot.

(4) Establish an intelligence platform that, in industrial environments and on the basis of multimodal observations covering the actions of both humans and multiple robots, autonomously selects, switches, and adapts learned collaboration policies according to the situation across multiple levels of collaboration.

(5) Compile recommendations toward safety standards for humanoid robots performing on-site work.

Project structure



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

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