Moonshot Goal3

PD's policy

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1. Recruitment and Selection Policy, etc.

(1) Regarding Recruitment

In Moonshot Goal 3, we aim to "Realization of AI robots that autonomously learn, adapt to their environment, evolve itself in intelligence and act alongside human beings, by 2050." As stated in the revised draft of R&D concept (Moonshot Goal 3), in the face of rapid advancements in AI and domestic and international trends, we will focus on the R&D of general-purpose autonomous humanoid AI robots in the latter half of the five years, from the perspective of solving social issues and aiming for disruptive innovation in the real world. The objective for 2050 is 'True General-purpose Autonomy' not merely achieving goals through optimization in specialized areas or through repeated machine learning and parameter adjustments. We aim to realize general-purpose autonomous humanoid AI robots that can flexibly perform anything humans can and empathize with human values and emotions. Currently, R&D activities for humanoid AI robots are active worldwide; however, in reality, specific tasks are achieved through extensive learning and parameter adjustments, and as tasks change, relearning and parameter adjustments are required. To truly complete a series of tasks from start to finish on par with humans and quickly adapt to new tasks, significant innovations in R&D are still necessary. We anticipate proposals that boldly

combine elements from different research fields, offering unprecedented challenges without being constrained by existing technologies. We also encourage young leaders currently challenging the frontiers of AI research and capable of leading pioneering research in 2050 to apply courageously.

(2) Recruitment and Selection Policy

Please choose one of the following three research categories and apply.

① Integrated Research

(Total budget limit over 5 years: 3 billion yen (direct costs).
/ Approximately 2 to 3 projects expected to be selected.)

In this call for proposals, we will solicit 'Integrated Research' aimed at the realization of general-purpose autonomous humanoid AI robots, backcasting from the vision of society in 2050 and drawing an overall scenario. In 'Integrated Research' it is a condition that the project must be a fusion of a 'Task Execution Capability Team' which develops intelligence to complete a series of tasks, and a 'Robot Platform Team' which develops new robot bodies based on the concept of embodiment. While we generally assume full-body general-purpose autonomous humanoid AI robots, other forms are not excluded. To achieve the 2030 target of developing prototypes for private investment as stated in the revised draft of R&D concept, it must also be an integrated R&D initiative that includes collaborations between industry and academia, implementation and application in society, and addressing ethical, legal, and social issues (ELSI). This 'Integrated Research' is the centerpiece of this call for proposals. We are considering selecting projects of various sizes, and at least one of them will be a project led primarily by young researchers, capable of continuing into 2050.

② Specialized Research

(Total budget limit over 5 years: 1 billion yen (direct costs).
/ Approximately 2 to 4 projects expected to be selected.)

We will solicit 'Specialized Research' aimed at the partial realization of general-purpose autonomous humanoid AI robots, such as the development of robot hands, rather than the entire scope of R&D like 'Integrated Research'. This research category applies to cases involving only the 'Task Execution Capability Team' which develops intelligence to complete a series of tasks, or only the 'Robot Platform Team' which develops new robot bodies based on the concept of embodiment. Proposals led by corporations or startups are also welcome. To more effectively achieve the 2030 target of developing prototypes for private investment as stated in the revised draft of the R&D concept, there is potential for developing collaborative research and strengthening partnerships with other complementary projects during the development period and after the start of the research. Costs related to increasing the number of prototypes for supply to other projects, as well as expenses necessary for collaborative research and partnerships, may be addressed with additional measures.

③ Elemental Research

(Total budget limit over 5 years: 100 million yen (direct costs).
/ Approximately 4 to 8 projects expected to be selected.)

We will solicit 'Elemental Research' aimed at realizing general-purpose autonomous humanoid AI robots envisioned in the societal image of 2050. Although these research areas are not yet established, they are highly novel studies that could significantly change the way AI robots are made and their performance in the future. In 'Elemental Research', we particularly expect R&D themes mentioned initially for achieving 'True General-purpose Autonomy' in humanoid AI robots (such as cognitive development) or themes that could fundamentally alter the structure and operational principles of the

body (such as embodiment). This research category also emphasizes nurturing young researchers. Proposals from young researchers across various fields are welcome, even with small team compositions. The R&D period for this 'Elemental Research' is principally until the end of November 2028. However, projects deemed likely to have promising R&D potential during the evaluation in the first half of the 2028 fiscal year may be extended by an additional two years or could evolve into collaborative research and strengthened alliances with other projects.

Approach to Overall Structure of Research Categories and Selection.

Figure 1 shows an example of a proposed project structure. Selection will be made considering the overall program portfolio. In addition to the proposed research content, evaluation will focus on whether the composition of necessary and sufficient R&D items is present and whether the proposal is made in an efficient and refined manner without waste. Applicants should strictly refrain from unnecessarily increasing research items or structure to match the budget limit. Also, since AI robotics is a rapidly progressing field, all projects may undergo plan and budget revisions during interim evaluations (first half of the 2028 fiscal year) or as needed, in response to rapid shifts in domestic and international trends and national policies.

(3) Proposal details

Your proposal must include the following.

① Presenting scenarios for 2050

For 'Integrated Research', 'Specialized Research', and 'Elemental Research', please propose a scenario leading to the realization of general-purpose autonomous humanoid AI robots coexisting with humans by 2050. Below are the 2050 objectives and societal vision aimed for in Goal 3, as well as the

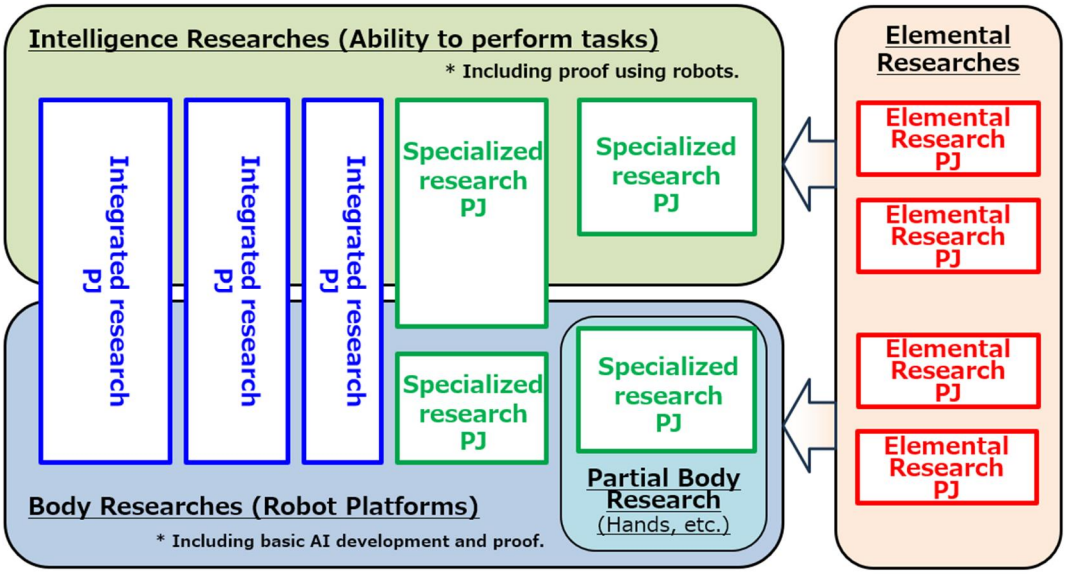

Figure 1: Example of project structure envisioned for the second half of the 5-year period in Goal 3.

target for 2030 (revised draft).

The goal for 2050 is to “Realization of AI robots that autonomously learn, adapt to their environment, evolve itself in intelligence and act alongside human beings, by 2050.” More specifically, to aim for a world where AI robots seamlessly support every aspect of human society and significantly enhance people's well-being, the objective is to realize general-purpose autonomous humanoid AI robots that can flexibly perform anything humans can do and empathize with human values and emotions.

The revised draft’s targets for 2030 are as follows:

- By 2030, development of a prototype of general-purpose autonomous humanoid AI robots capable of completing a series of tasks in specific locations with human assistance, adapting to changing conditions seamlessly and practically, and that is suitable for private investment.
- By 2030, establishment of the foundations for development elements to realize general-purpose autonomous humanoid AI robots capable of adapting to any situation.

Based on the goals for 2050 and targets for 2030, please propose an R&D scenario that includes the technological challenges that need to be addressed and their solutions. It is necessary to engage in challenging R&D through interdisciplinary fusion, not just by combining existing technological elements. For example, we expect R&D with new ideas through the fusion of AI and robotics, such as new systems through the organic integration of hardware and AI considering embodiment, and the evolution and expansion of cognitive development.

② Specific examples of targets to be achieved and verification methods

Related to the scenario in the previous section, please provide specific goals and demonstration methods for 2030 (2028 for 'Elemental Research').

ｉ） In Integrated Research and Specialized Research including intelligence research

Please propose the necessary R&D items for achieving 'True General-purpose Autonomy,' along with the task settings, condition settings, and disturbance settings required to demonstrate it. We expect the verification of intelligence and mechanisms that can carry out a meaningful sequence of tasks to the end, even in the presence of disturbances. Tasks can be freely set as long as they represent a practically useful high goal. Below, we show the level of tasks expected by 2030, merely as an example.

For example, considering the task of 'dressing', the sequence of tasks would include receiving the command 'please dress', retrieving clothes from the drawer, spreading them out, unbuttoning, assisting in dressing, and fastening buttons. Naturally, this also includes appropriate interaction with the person being dressed. Conditions include how tolerant the system is to the types of clothes in the drawer, their folded state, the posture of the person being

dressed, whether the hands used are general or specialized, and so on. Disturbances refer to the unexpected events caused by external factors (such as the clothes not being in their expected location, a button that should have been fastened coming undone, a sleeve being inside out, etc.), and to what extent the system can still achieve the goal of 'dressing' under such circumstances. Therefore, understanding the meaning of the objective 'dressing', generating actions, and the mechanisms to complete the task under the given meanings are crucial. As mentioned earlier, this is merely an example. Tasks can be considered in a wide range from 'cleaning', 'assembly', to 'scientific experiments' or 'disaster site operations', but please propose appropriate and verifiable settings to demonstrate the outcomes of the R&D items.

The goal is to achieve the capability to complete a series of tasks in a general manner, in other words, 'True General-purpose Autonomy,' and merely realizing specific actions through extensive learning is not the proposal we are expecting.

ⅱ）<u>In Integrated Research and Specialized Research including body research</u>

To realize a general-purpose autonomous humanoid AI robot, please identify the bottleneck elements in its physical structure and provide solutions for them, along with proposals for task settings, condition settings, and disturbance settings to demonstrate these solutions. We expect the ability to perform tasks that are useful as human substitutes, rather than simply pursuing basic physical abilities (such as running speed or somersaults). Tasks can be freely set as long as they represent practically useful high goals. Below are examples of the level of tasks expected by 2030.

For instance, as a task setting, there could be scenarios like climbing up and down scaffolding at construction sites. Achieving complex motions includes

challenges such as balancing power with lightweight design to support the entire body with hands, for example. In this case, conditions might include the complexity of the scaffolding and whether cargo needs to be carried. Disturbances refer to unexpected obstacles on the path or parts of the scaffolding that might be missing.

Even when partially developing components such as hands for a general-purpose autonomous humanoid AI robot, please include task settings, condition settings, and disturbance settings in your proposal. It is a prerequisite that components like hands, including their power sources and sizes, are designed to be attached to humanoid AI robots. Additionally, even in hardware-centric R&D, it is a condition that systems should be designed with integration with AI in mind.

We also expect this to become a robot platform used by many researchers and system integrators in the future.

R&D into new intelligent mechanisms based on embodiment is also expected. In passive walking, stable bipedal walking is achieved solely by the physical dynamics of the body and environment. It is possible to interpret this as the physical system implementing control calculations without electronic circuits. We strongly expect the expansion and generalization of such principles to establish methods for achieving a variety of practical actions with minimal computation, in a stable, reliable, efficient, and adaptive manner. Moreover, we anticipate the establishment of new methodologies for constructing AI grounded in the real world, based on these principles and effectively integrating with them. These efforts are expected to lead to rapid adaptation and understanding of diverse real-world situations, assurance of safety and reliability, significantly reduced energy consumption in computation and power, and better physical design suited to these applications.

ⅲ）In Elemental Research

Identify the bottleneck elements and their solutions necessary for realizing a general-purpose autonomous humanoid AI robot by 2050 and propose how verification and evaluation will be conducted in the first half of the fiscal year 2028. (The 'Elemental Research' period is generally set until the end of November 2028.) Since we are assuming highly novel research that is not yet established, we expect the foundation to be established by the first half of the fiscal year 2028. This indicates that the hypothesis and direction of the research are correct, and that there is potential for achieving innovative results through continued research.

2．Points to note when promoting R&D

(1) Portfolio Management

As part of constructing the overall portfolio for this goal, collaboration or competition among Project Managers (PMs) will be encouraged, taking into consideration the relationships between multiple R&D projects. Therefore, during the refinement period set after being hired as a PM, you will work with the Program Director (PD) to clarify the milestones aimed for, review reasonable promotion plans and budget plans, based on the scenarios proposed in each project. As you are aware, the field of AI robots is rapidly evolving, and it will be possible to adopt an optimal different research approach after consulting with the PD and according to the progress of the research.

(2) Industry-academia-government collaboration

For R&D to progress towards the goal of 2050, it is necessary to generate outcomes that support the development of various industries and to expand applications through this Moonshot program. Therefore, in Integrated

Research and Specialized Research, we strongly expect cooperation and joint development with the industrial sector towards the goal of developing a prototype of a general-purpose autonomous humanoid AI robot by 2030 that could potentially attract private investment.

Additionally, depending on the technology targeted for R&D, collaboration and cooperation with Moonshot goal 1 or other project initiatives may be sought.

(3) International Collaboration and Global Competitiveness

In implementing R&D projects, establish forums for information gathering, such as international symposiums, to consistently grasp R&D trends both domestically and internationally, and aim for world-leading outcomes. Collaborate actively with overseas institutions as necessary for R&D. However, when collaborating with overseas institutions, ensure that your proposal includes considerations regarding security.