

6.1.4 Symbiotic Interaction: Creation and development of core technologies interfacing human and information environments

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Overview

The integration of cyberspace with the real world is rapidly advancing based on improvements in artificial intelligence, data analytics, and the internet of things, which are penetrating our society. We must extend the research field of the interaction of humans and computers to achieve “interaction with networked ambient intelligence.” Recent technologies are showing us a future vision of smart information environments and augmentation of human abilities. Within this research area, we aim to create and develop core information technologies that realize advanced interaction designs for a symbiotic society consisting of humans, augmented humans, connected things, ambient intelligence (i.e., a smart intelligence environment), internet of wisdoms, etc. We will call this advanced interaction in the symbiotic society, “symbiotic interaction.” In this research program, we aim to create and develop the fundamental technologies that realize symbiotic interaction based on understanding and designing interactions in a symbiotic society.

The goal of this research area is to establish core technologies of symbiotic interactions through approaches that evaluate behaviors of humans and societies, designing future societies, and constructing effective interactive systems. Proposals are expected to include state-of-the-art technologies in appropriate areas such as human-computer interaction, ubiquitous/wearable information processing, computer science, and robotics, in addition to collaboration with other disciplines such as cognitive science, social science, and brain science.

Specifically, the following types of research and development will be pursued:

- 1) Development of technologies to augment human abilities for advanced interactions and interfacing with ambient intelligence
- 2) Development of technologies to advance and explain interaction theory, principles, and mechanism through collective data analytics for deep understanding of human behaviors and interactions
- 3) Design and development of ambient intelligence that fosters effective and efficient social structures and human creative activities when combined with advanced interaction technologies

Following these aspects, research and development efforts will contribute to establishing a harmonized and globally-optimized human and computer symbiotic society that is benefited by rapidly advancing artificial intelligence (AI) technologies and fundamentals.

This research area will be operated as part of the Advanced Integrated Intelligence Platform project (AIP project) by the Japanese Ministry of Education, Culture, Sports, Science and Technology.

Research Supervisor’s Policy on Call for Application, Selection, and Management of the Research Area

Background and basic policies

The integration of cyberspace with the real world is advancing rapidly based on the technologies of artificial intelligence, data analytics, and the internet of things. Our society is rapidly changing into a symbiotic society with networked and smart information environments, i.e., ambient intelligences. Augmented humans will harmoniously inhabit the society. In such a society, human, economic, and social

resources will be efficiently exploited by humans. The lifestyle and “work-style” will be significantly changed in the future society. To realize a symbiotic society with maximum benefit to humans, we must design novel interactions between humans and computers, and the future architecture of society.

We must extend the research field of the interactions among humans, and between humans and computers, to consider “interactions with networked ambient intelligences.” The various kinds of interactions of “human and human,” “human and computers,” and “human and ambient intelligence” will be investigated to pursue fundamental technologies that support human lives not only in the real world, but also in cyberspace. The design of such interactions should take into account continued technology development such that human augmentation and networked intelligent environments become increasingly advanced. Good understanding and control of the behaviors of humans, computers, and information environments will lead to optimal systems and architecture designs of human society and human activities. This understanding will foster the realization of an advanced society that fully exploits rapidly expanding AI technologies.

Research Goal

The goal of this research area is to establish core information technologies regarding symbiotic interactions through approaches that evaluate behaviors of human and society, designing future societies, and constructing effective interactive systems.

We envision a society in which numerous (e.g., several tens or hundreds) intelligent agents will work for humans by presenting a huge amount of information in a human-readable form in the next few years. The control of interaction with these large numbers of agents will be a very important job in our everyday lives. Not all agents will provide correct information. Humans may soon acquire thousands of times the power of their native intellect and physical capabilities with the help of human ability augmentation. We must understand our cognitive load in the predicted future society and design appropriate interaction designs to allow people to cope with such an environment. For example, what is an appropriate design of AI-supported automatic driving cars and home service robots for effective and safety control and use? Research project proposal applications are expected to outline such a future vision as its basis.

We aim to design a future-society architecture with an information environment in which people and communities are motivated to pursue safe and healthy lives based on the understanding of human behavior with the help of other disciplines such as cognitive science, brain science, and social science. When using various approaches of designing interactions, common fundamental theories such as the computational theory of interaction, design theory, and design principles are expected to be developed. The construction and sharing of interaction system platforms is also an issue. The collection and sharing of behavior data in the information environment is another important research area for new interaction analysis methods and practices. Ethical, legal, and social issues (ELSI) must be addressed in current research, development, and deployment. To deploy new technologies of interaction with a view of the future, creativity approaches to new social agreements within ELSI should be used.

Examples of research themes

Examples of research and development projects are as follows:

- Human Augmentation
 - Support technology for advanced multi-modal communication
 - Technologies to augment communication intelligence
 - Support technology for advanced collaborative work and community formation
 - Support technology for behavior alternation

- Augmentation technology for abilities and functions of humans (for the disabled, sports players, VR, etc.)
- Creativity support technology via interactions (design, computational creativity, computational design, etc.)
- Kansei design (collective computational intelligence)
- Recognition technology for interests and likes for clarifications of sense of values
- Systemization of knowledge, wisdom, and skills for wearable and ubiquitous information environments
- Ambient Intelligence
 - Multimodal interaction technologies with intelligent agents, intelligent robots, etc.
 - Interaction design technologies for intelligent systems, self-driving cars, and smart homes
 - Networked life-logging environments
 - Development of agents/robots equipped with interaction intelligence based in collected lifelogs
 - Interaction technology for co-creative communication and collaborative work
 - Technologies to create services adaptive to changing needs and circumstances
- Fundamental interaction theory and modeling
 - Modeling of augmented-human interactions
 - System design principles based on relations between humans and ambient intelligences
 - Computational design theory that leads to scientific interaction design
 - Theories of coaching
 - Models of communication knowledge/skill/intelligence
 - Intimacy model for robots and agents
 - Affective computing and control theory for mental health care
- Platforms
 - Platform technology to support data collection, analysis, sharing, and circulation of human behaviors and social phenomena

The domains of applicable interactions are education, medicine, health-care, distribution, manufacturing, infrastructure, transportation, sports, etc. One must illustrate a clear picture of interaction in these domains in the proposal. Creation of a collaborative team focused on cognitive science, social science, and brain science is plausible. Some examples of interactions include humans (augmented humans) and ambient intelligences, different cultures/languages, healthy and handicapped people, doctors and patients, coach and players, and parents and children.

In our research and development projects, we are looking for researchers who engage in the research and envision a specific path to implementation in society while considering ELSI. We anticipate that the achievements of the research will be deployed widely, both in Japan and abroad.

These fundamental technologies must be pursued in human-computer interaction, human-robot interaction, multi-modal interaction, intelligent user interfaces, autonomous agents, virtual reality, augmented reality, mixed reality, wearable devices, augmented humans, ambient intelligence, creativity support, and related research areas. We are seeking research projects that develop (and create in parallel) novel values and future services through an iterative loop of data collection, analytics, design, and implementation. Design thinking and actuation technologies are key components.

Collaborative workshops will be organized for interactions among research teams to investigate new research issues. Additional taskforce teams will be formed by the researchers in cognitive science, brain science, etc., to tackle and solve common issues in their related research domains and to share the results among the teams.

Research period and research expenses

Proposals will be solicited for the entire research period of five years and six months (from October 2017 through March 2023). Research costs will be up to a total of 300 million yen for the entire period. Timely evaluation of research progress will be performed by the research supervisor and informed by the advisory panel. Additional budget will be provided at any time when acceleration is considered useful and appropriate during the research period for activities such as large field experiments of the construction of public and appealing systems.

Notes for the preparation of research proposals

(E-1) In the research proposal, the following specific objectives must be provided:

- A specific objective to be achieved in five years and six months
- A specific objective to be achieved in the two years and six months before the interim evaluation

(E-2) The budget plan should specify a budget of 300 million yen for the entire period of five years and six months.

(E-3) The proposal should identify,

- i) the applicable domains of research achievement such as education, medicine, health-care, distribution, manufacturing, infrastructure, transportation, and sports; targeted interactions, using what form, user model, and system model; and
- ii) any developing technologies, theories, or designs planned.

More specifically, please give descriptions of the following items in "1. Outline of the Research Project" of the application form (page 2, Form 2).

- 1-1) Applicable domain,
- 1-2) Social needs of proposed research, with its impact on society,
- 1-3) Novelty and originality of core technology or concept,
- 1-4) Challenging topic and international competition,
- 1-5) The best team in the field, and
- 1-6) Future vision of ELSI.

(E-4) In this research area, applications with simple interface devices, gadgets, and interaction tricks that have only short-term appeal will not be considered for acceptance. We expect research proposals with well-thought-out ideas and concept with feasible plans, which we think will be the outcome of strong will to change the world and society in the coming decades.

(E-5) In this research area, we make an open call to contributions from industry for open innovation with the provision of working prototype systems and data in various forms such as robots, interaction logs, etc. After the review of proposals from industry, we will announce the list of contributions to the applicants for their reference. Applicants are expected to make contact directly.

(E-6) The proposal are suggested to include a proactive study of collaboration with companies, local governments, etc., in addition to a plan to launch startup companies. With regard to the content of the research, applicants should give consideration to finding research topics among the problems currently faced by society, with a view to eventual implementation in society.

(E-7) In addition, young team leader is called. It is also important to consider allowing junior researchers to be involved in the research team. In terms of junior researcher training, we hope that involvement will not

be limited to university researchers, but instead, that company researchers and outstanding students in continuing education doctoral programs will also be able to join the research team.

This research area will also contribute in the integrated administration of the AIP project (which integrates artificial intelligence, big data, IoT, and cyber security) by working on research tasks in cooperation with related research institutions such as the RIKEN Center for Advanced Integrated Intelligence Research. This is one of the research areas included in the AIP Network Laboratory, which is part of the AIP project.

* To apply, download the correct form from the JST website for Research Proposals.

* The briefing sessions for the call for proposals in this research area will be held on the following dates at the following locations. We hope that all interested parties will attend.

	Date & Time	Venue
Kyoto	April 18th (Tue) 13:00–16:00	Mielparque-Kyoto 5th Floor “Conference room B” Higashi-shiokoji-chou 676-13, Higashino-Toin-dori Shichijyo Sagaru, Shimogyo-ku, Kyoto
Tokyo	April 19th (Wed) 14:00–17:00	JST Tokyo Headquarters Annex, 1st Floor Hall K’s Gobancho, 7, Chiyoda-ku

For more information, please visit the following site: <http://www.senryaku.jst.go.jp/teian-en.html>