Symbiotic Society with Avatars (SSA): Beyond Space and Time

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Figure 1: Avatars can have different embodiments, functionalities, and representations. A) Rubika computer-generated 3D avatar, a virtual agent that can interact with users in different setups. B) The HI-6 robot is a humanoid robot that can have daily conversations with users. C) Gene, a computer-generated anime-style avatar.

ABSTRACT

Avatar robots can help people extend their physical, cognitive, and perceptual capabilities, allowing people to exceed time and space constraints. In that sense, avatar robots can greatly influence people's lives. However, we have many challenges to be addressed in various scenarios such as avatar-human interaction, operator-avatar interaction, avatar-avatar interaction, ethical and legal issues, technical challenges, and so on. It is indispensable to discuss what the necessary research and technologies are to realize avatars that are well accepted in society while envisioning a future symbiotic society in which people communicate with other people and their avatars. In our previous workshop "Symbiotic Society with Avatars: Social Acceptance, Ethics, and Technologies (SSA)" we focused on the ethical aspect of avatars. In this workshop, our aim is to provide an opportunity for researchers from different backgrounds including social robotics, teleoperation, and mixed reality to come together and discuss the advances and values in a symbiotic society with avatars. All materials can be found on the workshop's website[1]

[1] https://sites.google.com/view/ssa-hri

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CCS CONCEPTS

• **Human-centered computing** → **Activity centered design**; *HCI design and evaluation methods.*

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1 BACKGROUND

Avatar as a word is defined as "an incarnation, embodiment, or manifestation of a person or idea". In the field of robotics, avatar robots are categorized into two main classes. The first class includes robotic systems that are controlled by a user (often called a teleoperator). The avatar robot helps users transport their senses (e.g., vision, hearing, etc.) [13], actions (e.g., move, grasp, etc.) [12], and presence to a new location. The distance between the user and the avatar can range from a few meters (e.g., a doctor controlling a surgical robot) in which the avatar and the user are co-located, to millions of kilometers (e.g., Mars Exploration Rovers). These systems empower users to achieve goals in impossible-to-reach places (e.g., space exploration), difficult-to-reach (e.g., inspecting a bridge, search and rescue), and dangerous places (e.g., inspecting hazardous materials in a nuclear power plant).

Second, an avatar can be defined as a piece of software that has human embodiments (e.g., an autonomous humanoid robot) [3, 4]

or a virtual representation of a human (e.g., a virtual agent) [7]. The concept of avatars in video games is one of the most famous examples in this category. This class of avatars is useful for repetitive tasks, for example, robot receptions at hotels, which most of the time do straightforward tasks (e.g., help with check-in, run the credit card, etc.).

Most traditional avatars emerge as on-screen agents (Fig.1 A & C) or as teleoperation robots [14]. However, with advances in technology in the last few years, new avatars emerged using new display technologies such as Augmented reality [10, 15, 20], virtual reality [18], projection [1], and etc. Moreover, with advances in mechatronics and AI, more sophisticated and capable humanoid avatars appeared (e.g., Fig.1 B). These advances accelerate the research and grabed more attention of researchers.

In recent years, researchers have studied the effect of using avatars in a variety of scenarios in the field of human-robot interaction. For example, the effect of improving human-robot conversations [8, 9, 19], reducing user anxiety [22], etc. reduce the user's mental workload [2]. Furthermore, researchers have explored the effect of avatar embodiment on users (e.g., size, etc.) [21]. As a result of these efforts, we see more robots in the real world such as shopping malls [5, 6, 17], amusement parks [11], etc.

Avatars are not only used in research environments; there are many examples of avatars deployed in the shopping malls which help the customers [16], helps them find directions in buildings, and in amusement parks. Given the situation of the COVID-19 pandemic, we see an increase in avatar usage, especially in the creative community (e.g., YouTube, etc.).

Our vision is that we can completely eliminate barriers to distance and time through advances in avatar technologies. This helps humanity to finally be able to reach its full potential. This is the reason we select this name for this workshop: "Beyond space and time," although we have a long road to travel before we reach that destination.

2 WORKSHOP OVERVIEW

We follow the common ground established by the previous SSA workshop held in RO-MAN 2022. We run a half-day workshop. We invited two highly prestigious and well-known researchers who are experts in the area of Avatars and Social robotics as the keynote speakers. Each keynote follows with a *Q&A* session. Then five of the organizers give a short address on the advances and challenges of the field. Finally, there are a poster session and lightning talks from participants submited papers to our workshop. Our distinguished keynote speakers are **Dr. Julie A. Adams** at the Oregon State University and **Dr. Hannes H. Vilhjálmsson** at Reykjavik University.

Although we hope to hold the workshop in person, we prepare the necessary equipment and infrastructure for possible online participants to attend (e.g., video conference, Slack channel, etc.). All organizers plan to participate in the workshop in person. Based on the data of our previous workshop which was held at RO-MAN 22, and average number of attandance in HRI, we expect an attendance of around 30 people. We encourage researchers to submit 2-4 page extended abstracts on previous, current, or proposed work. Each submission would be reviewed by at least two reviewers and the accepted extended abstracts will be hosted on the workshop website

3 ORGANIZING TEAM

The organizing team consists of various researchers working on the topic related to this workshop.

Hooman Hedayati is a post-doc researcher at Kyoto University. Before joining Kyoto University, he finished his Ph.D. at the Department of Computer Science of the University of Colorado Boulder. He worked in highly prestigious research labs such as Microsoft Research and Disney Research. His work includes studying the interactions between flying robots and humans, developing algorithms to support more socially sensitive behavior for robots, and using augmented reality to make working with robots more productive and safer.

Stela H. Seo is an assistant professor in Informatics at Kyoto University, Japan. He received his Bachelor of Computer Science at the University of Manitoba in 2012. At the University of Manitoba, he continued his academic journey and received his M.Sc. and Ph.D. in Human-Robot Interaction in 2015 and 2021 respectively. He started his career as an assistant professor in 2021. He is interested in researching social teleoperation, teleoperation interface designs, multi-robot operations, social human-robot interaction, and interactive content designs.

Takayuki Kanda is a professor in Informatics at Kyoto University, Japan. He is also a Visiting Group Leader at ATR Intelligent Robotics and Communication Laboratories, Kyoto, Japan. He received his B. Eng, M. Eng, and Ph. D. degrees in computer science from Kyoto University, Kyoto, Japan, in 1998, 2000, and 2003, respectively. He is one of ATR's starting members of the Communication Robots project. He has developed a communication robot, Robovie, and applied it in daily situations, such as peer-tutor at elementary school and as a museum exhibit guide. His research interests include human-robot interaction, interactive humanoid robots, and field trials.

Daniel J. Rea is an Assistant Professor at the University of New Brunswick and a frequent visitor at Kyoto University with Dr. Takayuki Kanda, and earned his M.Sc. and Ph.D. at the University of Manitoba in 2015 and 2020. His focus is on user-centered design to improve the performance and experience of people remotely controlling robots. Side research interests include game design and applying game design to robotics and other fields, as well as social human-robot interaction, interaction design, and virtual reality.

Sean Andrist is a senior researcher at Microsoft Research in Redmond, Washington. His research interests involve designing, building, and evaluating socially interactive technologies that are physically situated in the open world, particularly embodied virtual agents and robots. He is currently working on the Platform

for Situated Intelligence project, an open-source framework designed to accelerate research and development on a broad class of multimodal, integrative-AI applications. He received his Ph.D. from the University of Wisconsin–Madison, where he primarily researched effective social gaze behaviors in human-robot and human-agent interaction.

Yukiko Nakano is a professor in the Department of Computer and Information Science at Seikei University, Japan, and leads the Intelligent User Interface Laboratory (IUI lab). She received her M.S. in Media Arts and Sciences from the Massachusetts Institute of Technology, the USA, and a Ph.D. in Information Science and Technology from the University of Tokyo, Japan. With the goal of allowing more natural human-computer interaction, she has addressed issues on modeling conversations by analyzing human verbal and non-verbal communicative behaviors. Based on the empirical models, she has developed Multimodal Conversational Interfaces. She has served as a program committee member for over 30 major international conferences and as a co-chair and a senior program committee member for major international conferences targeting interaction and intelligent agents including IUI, ICMI, AAMAS, and IVA.

Hiroshi Ishiguro received a Ph.D. in systems engineering from the Osaka University, Japan in 1991. He is currently a Professor in the Department of Systems Innovation in the Graduate School of Engineering Science at Osaka University (2009-) and Visiting Director (2011-) of Hiroshi Ishiguro Laboratories at the Advanced Telecommunications Research Institute (ATR). He is also a Distinguished Professor at Osaka University and an ATR fellow (one of six fellows). His research interests are interactive robotics, avatar technology, and android science. He has developed many interactive humanoids and androids, called Robovie, Repliee, Geminoid, Telenoid, Elfoid, CommU, ERICA, and Ibuki. These robots have been reported by media such as Discovery Channel, NHK, and BBC. In particular, Android research and development is world-famous. In 2011, he won the Osaka Cultural Award. In 2015, he received the Prize for Science and Technology from the Minister of Education, Culture, Sports, Science, and Technology (MEXT). He was also awarded the Sheikh Mohammed Bin Rashid Al Maktoum Knowledge Award in Dubai in 2015. Tateisi Award in 2020, and an honorary doctorate from Aarhus university in 2021.

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