Robotization of Everyday Life

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1. Robotization of Everyday Life

Our everyday life comes with many problems, such as increased stress of child-rearing and nursing due to the low birth rate and rapidly aging society, mistrust in the safety of the manufactured products that are all around us, and large numbers of persons afflicted with adult diseases. The development of assistive technology for solving these problems is an urgent issue. To achieve assistance for everyday life, or in other words, to allow us to ‘control’ for improving the quality of everyday life, a computational model for control is indispensable. However, our everyday life presents us with physical phenomena that, in spite of being familiar, are actually not fully understood by our science and technology, so that there is no computational model for everyday life.

The development of information technology and robot technology (RT) in recent years has increased the feasibility of a computational approach in which everyday life is treated as an object of ‘control’ or ‘computation’ by representing everyday life itself on a computer as a kind of ‘system’. It is important to now engage in the science and technology for making our uncertain and difficult-to-control everyday life controllable by robotizing our life environment. In this article, ‘robotization of everyday life’ indicates actions and methodology for creating feedback systems that realize new assistive functions by adding new robotic elements to our everyday life situations and organizing the robotic elements for given purposes. We outline the everyday life robotization paradigm and its research challenge.

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2. Everyday Life Robotization Paradigm

It is becoming feasible to implement feedback systems for sensing, modeling and service provision in everyday life situations by integrating technology for sensing everyday life phenomena and technology for modeling everyday life from large-scale sensor data with everyday life assistance services. This ‘service integration’ enables a new methodology for knowledge acquisition that allows continuous development of technology and knowledge for supporting everyday life [1] (Fig. 1). In this everyday life robotization paradigm, the traditional simple distinction between basic research and applied research is not necessarily possible. This is a new paradigm in which a new science will be created on the foundation of a huge amount of data that can be obtained only through social implementation of actual services and that new scientific findings will be utilized through actual services to form a complete whole from foundation to application.

Targets of everyday life robotization range from public facilities including hospitals, day-care, stations parks and playground facilities to private areas, including ordinary households. As well as having isolated functions performed by single small-scale robot systems in these robotized fields, higher-level robotic systems can be constructed by organic integration of groups of these small-scale systems. In this way, robotization of the entire society can proceed, and a social feedback system in which small loops and large loops coexist can be constructed.

3. Research Challenge in Everyday Life Robotization

In the robotization of everyday life, a new human information science, also referred to as ‘everyday life informatics’, is created on the foundation of a huge amount of
data that can only be obtained through social implementation of actual services with everyday life robotics (Fig. 2). The cycle is then completed by returning that expertise to actual services implemented with ‘everyday life robotics’, thus achieving the development that integrates the two processes.

Research challenges in everyday life informatics and everyday life robotics are described below. The development of everyday life assistance technology requires a science of humans living in everyday life space. To this end, the collection of actual everyday life data as basic data and research on daily life modeling based on that basic data are indispensable. Even now, although it is possible to collect mock daily life data in a laboratory environment, the acquisition of actual everyday life data and the development of a computational model of everyday life based on that data remain important research topics for the future. One effective way to collect data on everyday life is to develop RT for daily necessities and use those machines to log life data on a large scale in actual service. Accordingly, from the viewpoint of actual everyday life data, the development of standard low-cost RT components and the development of middleware for agile organic integration and service implementation are also important research topics.

Next, the development of an everyday human life model based on large-scale actual everyday life data requires establishing an everyday life informatics (Fig. 2) as a basis. In contrast to Newtonian physics, where variables and equations that can be applied in common to diverse phenomena are being discovered, the physics of everyday life that we are concerned with has no known common governing variables. Instead, we have only a huge number of variables for describing daily life (the terms used in everyday life). Establishment of a variable selection and de-
The establishment of a systematic framework for controlling uncertain everyday life phenomena (everyday life robotics) is also important when we deal with not only understanding everyday life through everyday life informatics, but also engineering or industrial applications. As shown in Fig. 3, variables for explaining uncertain daily life phenomena can be classified as (A) variables ultimately to be controlled, (B) variables that can be changed and (C) important explanatory variables that cannot be changed. It is necessary to discover the causal structure among those variables and develop a way to control them. Finally, the design of a research organization that involves real fields that have specific needs and users is also important for the development of everyday life assistance services. One approach to that problem is to integrate research activities themselves with on-site services so that implementing one implements the other (Research as a Service [2, 3]).

Many fields of science with long histories have come to know the limits of their achievements at a given time by having an active relationship with society and responding to social problems. Such fields have been successful in breaking through those limits to rapidly advance theory and technology. Statistics, for example, has a history that spans more than three centuries and progress in that field has always grown from the soil of the production activities of the society of the time [4]. Active involvement with society is indispensable in the development of robotization technology for everyday life. That is connected to a true understanding of the barriers that must be broken and to new challenges. In that sense, society can be expected to provide a fertile soil for robot technology.
References


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Yoshifumi Nishida is a Team Leader of the Human Behavior Understanding team at the Digital Human Research Center (DHRC) of the National Institute of Advanced Industrial Science and Technology (AIST), Japan. He is also the Leader of the project ‘Sensing and Modeling Everyday Life Behavior for Injury Prevention’ of the Core Research for Evolutional Science and Technology Programs of the Japan Science and Technology Agency since 2005. He received a PhD from the Graduate School of Mechanical Engineering, University of Tokyo, in 1998. In 1998, he joined the Intelligent System Division of the Electrotechnical Laboratory at AIST of the Ministry of International Trade and Industry, Japan. In 2001, he joined the Digital Human Laboratory. He has been a Senior Research Scientist at DHRC since 2005. His research interests lies in human sensing technology and human-centered application, which includes personal activity sensing using environmental and body sensor networks, social activity sensing using the Internet, everyday life modeling and childhood injury prevention engineering. He is a member of the Robotics Society of Japan, and the Japanese Society of Artificial Intelligence.

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