Component Framework for Robotic Functional Services

Standardization and Future Extension of OMG RoIS (Robotic Interaction Service) Framework

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Abstract— **This paper introduces a standardization activity of robotic functional components framework. Though the existing standard provides a means to describe interface of robotic functional components and a set of basic components' definitions, it only focused on robotic functions such as sensing and actuation. When robots are used for services in social environments, users and developers of robotic components should pay attention to social aspects of such robotic functions, however, there is no such standard that provides way to describe them. This paper introduces the OMG RoIS (Robotic Interaction Service) Framework, a standard to define robotic functional components in Human Robot Interaction (HRI) situation. Firstly, the objectives, architecture and current status of RoIS are described, and then introduces further discussion to extend it in relation with other standards.**

I. Introduction

In the near future, robotic services are expected to be important factors to support daily activities, particularly for such super-aging societies as Japan. These societies face a critical social problem: encouraging the social participation of elderly people, especially those who are living alone or who require nursing care [1]. In this context, robotic services are expected to provide elderly people with necessary care from the viewpoints of both physical and mental support. In this situation, in addition to elderly people, robotic services can also support the activities of care givers, under a chronic labor shortage, to reduce burden of physical works and time consuming works so that they can provide care support more closely.

As well as elderly support services, in such super-aging societies, labor shortage becomes a common problem in retail services. Many researches focused on robotic services in shopping mall environments. From the viewpoint of human robot interaction (HRI), such robotic services focused on engagement with customers, understanding movement of crowds, recommendation in a retail shop, and navigation in a shopping mall.

As a next step, we focused on a study of general methodologies to implement such kind of social behaviors as robotic functional components. This study addresses on 1) extracting social behaviors of person in a shopping mall environment from large scale sensor data, 2) making robotic services that learn appropriate behaviors from human behaviors in the environment and 3) extending existing standards of robotic functional components to describe their functions from social aspects. This paper focuses on the last part of the research, that is, extensions to the one of the existing standards, OMG Robotic Interaction Service (RoIS) Framework.

Though the scope of the RoIS's component functions are originally limited to *interaction service*, the framework is capable of defining such kind of extension components. In the following part, standardization work of the OMG RoIS framework is firstly described and then ways to define extension components in the RoIS framework and discussions to extend the RoIS itself are presented.

II. Robotic Interaction Service Framework

As robotic services have grown, robotic systems and their development have become more complicated. Similar to traditional software engineering, people in robotic technology have started to seek modularity and the reusability of basic functional components and have invested in the development of common libraries and middleware.

Today, robot developers can share functional modules for robotic devices on common platforms and rapidly develop working robotic systems by adopting existing functional modules in combination with their own software. Such a modularized development process has accelerated the development of standalone robots as well as individual functional components; however, gaps exist between the development of robots and service applications.

Robotic Interaction Service (RoIS) Framework is a standard published from Object Management Group (OMG) that basically abstracts a robot as an HRI Engine and treats each HRI functional component as HRI Component. In OMG, the process of RoIS standardization started when its Request

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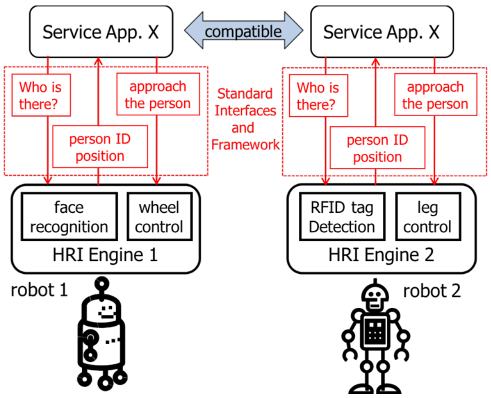

Fig. 1 RoIS service application programming style. The same service application program runs on different platforms with little modification.

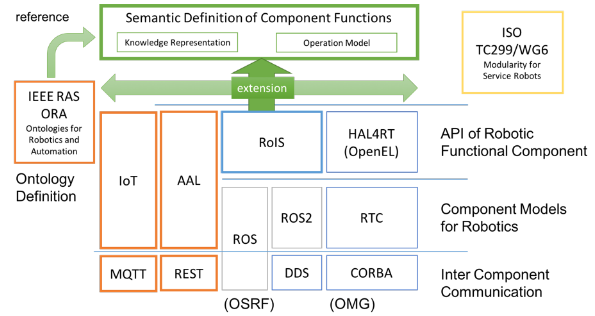

Fig. 2 Structure of the corresponding standards described from the viewpoint of component modularity.

for Proposal (RFP) was issued in June 2010. Initial drafts are submitted from two organizations and merged draft was submitted in June 2011. After 18 months' work of the RoIS 1.0 Finalization Task Force (FTF), the RoIS 1.0 standards was released in February 2013 [2]. After the release, the first revision of RoIS 1.1 is about to be released in 2016,, and the next Revision Task Force (RTF) for RoIS 1.2 has chartered recently.

Each HRI Component is developed based on its functional abstraction so some hardware may correspond to several HRI Components simultaneously. For example, a camera (or a pair of cameras in case of stereo vision) may be utilized in "Person detection," "Person identification" and "Face detection" HRI Components. An HRI Engine encapsulates HRI Components embodied in the robot hardware and works as a mediator between a service application program and the HRI Components so, when using the RoIS concept, it is important to standardize mechanisms for the information and instructions exchanged between the service application and the HRI Engine. (Fig. 1)

From the viewpoint of a service application, there are generally two types of information to be exchanged: Active Information and Passive Information. Active Information is actively solicited by the service application, for example "check presence/absence of human" and "get position of the person." On the other hand, Passive Information is provided when relevant data is obtained or changed in the HRI Engine, for example "the robot has detected a person" or "the robot has arrived at the target position."

Referring to the RoIS 1.0 specification, there are two implementations of that technology, one from ETRI, Korea and another from ATR, Japan were presented in OMG robotics information day in December 2012. The latter is released as Ubiquitous Network Robot Platform (UNR-PF) that implements several standards including RoIS and provides a common infrastructure for cloud networked robot services [3].

III. Extension to the Existing Standards of Robotic Interaction Service Framework

Since RoIS 1.0 merely provided a flat set of basic components, the specifications of the component profile seemed insufficient to describe hierarchical relationships among component classes, that appeared application development in field experiments. In RoIS 1.1, an example case of such hierarchical relationships are incorporated as an appendix section. Though it was possible to describe such relationship using current RoIS specification, they should be directly described. Since class hierarchy also indicates the semantic relationship among a set of functions defined in the classes, such semantics should be described using the formal method of ontologies.

Fig. 2 describes possible extension of RoIS standards accompanied by ontology definition for service robotics. Such ontology for robotic services are required to define semantic relationship of functional services, for example, pre-condition or post-condition of execution of a function, and existing IEEE RAS standard ontology [4] does not cover ontology for such services, several standards will be required for robotic service ontology, generalized RoIS framework, and concrete definition of extended robotic functional services using such ontology and framework.

References

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