IROS 2007 Workshop on ***Ubiquitous Robotic Space Design and Applications***

Nov. 2, San Diego, CA, USA

No.	Name	Affiliation	Presentation title	Time
Welcome and introduction to the workshop				9:00 - 9:10
1	Hideki Hashimoto	The university of Tokyo, Japan	Intelligent Space: Advanced Integration of RT (Robot Technology) and IT (Information Technology)	9:10 - 9:40
2	Gérard G. Medioni	Univ. of Southern California, USA	Cooperation model of Multi-sensor Nodes for a Personal Service Robot	9:40 - 10:10
3	Yong-Moo Kwon	KIST, Korea	XML-based URS modeling and visualization	10:10 - 10:40
Break				10:40 - 11:00
4	Shigeki Sugano	Waseda University, Japan	Integration Design of Structured Environment and Dexterous Robot	11:00 - 11:30
5	Tetsuo Tomizawa	AIST, Japan	Introduction to Ubiqutous space related to Japan Science & Technology Agency Projects at AIST	11:30 - 12:00
Lunch				12:00 - 13:50
6	Gaurav Sukhatme	Univ. of Southern California, USA	Building Environmental Observing Systems using Robotic Sensor Networks	13:50 - 14:20
7	Makoto Mizukawa	Shibaura Institute of Technology, Japan	Functional design of environment for ambient intelligence	14:20 - 14:50
8	Wonpil Yu	ETRI, Korea	Wireless localization networks for indoor service robots	14:50 - 15:20
9	Minsu Jang	ETRI, Korea	Design and implementation of semantic space for ubiquitous robots	15:20 - 15:50
Break				15:50 - 16:00
10	Kang-Hee Lee	Samsung Electronics, Korea	Ubiquitous Robot S/W platform: anyrobot studio 1.0	16:00 - 16:30
11	Mathias Broxvall	Örebro University, Sweden	The PEIS Kernel: a Middleware for Ubiquitous Robotics	16:30 - 17:00
Discussion & Closing				17:00 - 17:30

Workshop Paper Abstracts

Intelligent Space: Advanced Integration of RT (Robot Technology) and IT (Information Technology)

Latest advances in network sensor technology and state of the art of mobile robotics and artificial intelligence research can be employed to develop autonomous and distributed monitoring systems. "Intelligent Space" is a platform on which it is possible to implement advanced technologies that enable easy realization of smart services to human. In the past we have developed and reported several systems and technologies used in the development and implementation of Intelligent Spaces. In this paper we will summarize the present state of Intelligent Space and try to describe the future work from the viewpoint of system integration. Also we are now introducing RT (Robot Technology) to develop the Intelligent Space as an actual standard platform that could be approved by Human-Robotics Community. We will discuss how to use RT in our Intelligent Space and show our new results.

Cooperation Model of Multi-sensor Nodes for a Personal Service Robot

We address issues dealing with visual perception for a personal service robot in the Intelligent Home environment. We identify key visual functionalities necessary for the robot to perform its activities. They include people detection and identification, gesture recognition, and self localization. We propose an efficient and reliable framework to organize and coordinate the vision sensor nodes: fixed cameras mounted on walls, and camera(s) on the mobile robot. We propose solutions to the different vision tasks, and present our implementation within this framework, validated with experimental results.

XML-based URS Modeling and Visualization

This paper presents URS (Ubiquitous Robotic Space) Modeling and visualization for the robotic security service while bridging between virtual space and physical space. First, this paper introduces a concept of virtual URS and responsive virtual URS. Second, this paper addresses modeling of URS which covers modeling of indoor space and environment sensor. Third, this paper describes our bridging system between virtual URS and physical URS according to sensor status change and robot movement. Finally, this paper addresses a visualization of a responsive virtual URS corresponding to events in physical URS. All processes are based on XML and web environment.

Integration Design of Structured Environment and Dexterous Robot

- Introduction (Waseda Robot)
  - Humanoid Robotics Institute
- Future Robots
  - Intelligence
- Mechanical Design
  - Intelligence Embodiment
- Structured Environment
  - Ubiquitous Sensors and Actuators
- Experiments in WABOT-HOUSE
  - Future Life Style
  - Positioning (Pseudolite) System

Introduction to Ubiquitous Space Related to Japan Science & Technology Agency Projects at AIST

- We are proposing "Universal Design for robots (structured environment)", and defining the sensor structure.
- We want to establish the method of selecting suitable sensors and suitable algorithms according to environment, demand specification, and capacity of the robot.
  - In order to make a combination change of sensors or localization algorithms easy, "RT-middleware" is used.
  - The combination is verified by the simulator. (by Open-HRP, Matlab ?)
- We will show some demonstration in a real home environment next year.

Functional Design of Environment for Ambient Intelligence

In this paper, we described the necessity of the infrastructures for ambient intelligence to operate robots in the domestic environment, and show that the base of system for the ambient intelligence to make robot providing effective services has been developed. This system would be highly expected to be used in many different situations.

Building Environmental Observing Systems using Robotic Sensor Networks

I will describe the design and prototyping of a robotic sensor network for making observations in aquatic environments. The system is composed of autonomous robot boats, submarines, and stationary moored nodes. I will describe algorithms for robotic exploration (where robots are aided by the stationary nodes) for the purpose of mapping environmental phenomena in the water.

Wireless Localization Networks for Indoor Service Robots

This paper presents wireless localization networks for locating stationary object in an indoor office environment. Actual experimental test results based on UWB (IEEE 802.15.4a), WLAN (IEEE 802.11), and ZigBee (IEEE 802.15.4) are briefly presented and advantages and disadvantages of each method are also addressed. A new method based on received signal strength index (RSSI) of radio signals emitted from fixed reference nodes is outlined. In the new method, mobile reference tags are used to detect signal strength accurately so that reliable signal propagation model can be produced.

Design and Implementation of Semantic Space for Ubiquitous Robots

Ubiquitous robotic space (URS) is a ubiquitous environment in which the networked robot plays the main role of managing the space and the services provided in it. The intelligent subsystem of the URS, which is called the semantic URS (SURS), is the high-level controller of the space. SURS integrates various input data from the space, interprets the data to understand the situations, decides and triggers the reactions. We built the SURS based on symbolic artificial intelligence with strong commitments to the semantic web standards. Symbolic data schema based on the standard representation mechanism of the semantic web promotes interoperability and dynamic data integration in the highly heterogeneous, dynamic, and distributed environments like URS. In this paper, we describe the structure and the functionalities of the SURS with accompanying simple examples.

Ubiquitous Robot S/W Platform: AnyRobot Studio 1.0

The standardized data may easily move within a network and connect to other systems without any time or

geographical limitations. This concept is fundamental to the idea of the ubiquitous robot. But the definitions of the ubiquitous robot or networked robot appear in different forms all over the world. This paper discusses those definitions briefly and describes the approach of Samsung Electronics Co., Ltd (SEC). Here we present AnyRobot Studio which covers all the aspects of this ubiquitous robot system. Based on the concepts of RUPI, URC, and Web 2.0, AnyRobot Studio aims to standardize the platforms and protocols, and to strongly encourage the participation of users and contents providers (CPs).

The PEIS Kernel: a Middleware for Ubiquitous Robotics

The fields of autonomous robotics and ambient intelligence are converging toward the vision of smart robotic environments, or ubiquitous robotics, in which tasks are performed via the cooperation of many simple networked robotic devices. The concept of Ecology of Physically Embedded Intelligent Systems, or PEIS-Ecology, combines insights from these fields to provide a new solution to building intelligent robots in the service of people. To enable this vision, we need a common communication and cooperation model that allows dynamically assembled ad-hoc networks of robotic devices, a flexible introspection and configuration model allowing automatic (re)configuration and that can be shared between robotic devices at different scales, ranging from standard mobile robots to tiny networked embedded devices. In this paper we discuss the development of a middleware suitable for ubiquitous robotics in general and PEIS-Ecologies in specific. Our middleware is suitable for building truly ubiquitous robotics applications, in which devices of very different scales and capabilities can cooperate in a uniform way. We discuss the principles and implementation of our middleware, and also pointto experimental results that show the viability of this concept.