Human Support Robot (HSR)

Takashi Yamamoto
Toyota Motor Corporation
tyamanoto@mail.toyota.co.jp

Tamaki Nishino
Toyota Motor Corporation
tamaki_nisino@mail.toyota.co.jp

Hideki Kajima
Toyota Motor Corporation
hideki_kajima@mail.toyota.co.jp

Mitsunori Ohta
Toyota Motor Corporation
mitsunori_ohta@mail.toyota.co.jp

Koichi Ikeda
Toyota Motor Corporation
koichi_ikeda@mail.toyota.co.jp

Figure 1: Human Support Robot(HSR)

ABSTRACT

There has been an increasing interest in mobile manipulators that is capable of performing physical work in living spaces worldwide, corresponding to population aging with declining birth rates with the expectation of improving quality of life (QOL). Research and development is a must in intelligent sensing and software which enable advanced recognition, judgment, and motion to realize household work by robots. In order to accelerate this research, we have developed a compact and safe research platform, Human Support Robot (HSR), which can be operated in an actual home environment. We assume that overall R&D will accelerate by using a common robot platform among many researchers since that enables them to share their research results. In this paper, we introduce HSR design and its utilization.

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CCS CONCEPTS

• **Computer systems organization** → *Robotics*;

KEYWORDS

mobile manipulator

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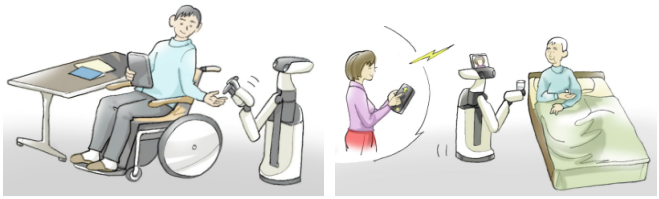
1 INTRODUCTION

The declining birthrate and aging population has become a serious social problem in many countries. As the society's aging rapidly advances, the shortage of workers and care workers has become a major issue[Agi 2016]. To improve Quality of Life (QoL), it is very important to promote the independence of people with disabilities

and the elderly as well as provide household support to these group and including general healthy people in terms of improving QoL. It is considered that developing a robot which alternate human work is one of solutions.

The Human Support Robot (HSR) introduced in this paper is a mobile manipulator robot which holds both functions of physical work and communication. [HSR 2015]. Figure 1 shows the appearance of HSR. HSR has been in development with the goal of conducting tasks such as operating on furniture (i.e. opening/closing drawers, using microwaves, etc...), fetch and carry of daily necessities, and tidying rooms up. It aims to support people having greater needs for daily life through the general public(Fig. 2).



(a) Independent living support **(b) Remote care support**

Figure 2: Image utilization of HSR

In order to achieve the realization of a robot which performs physical work at home, it requires tremendous development of software for executing tasks in the real environment in addition to the hardware which may coexist with people in the living space. In order to make it possible to operate in a real environment, HSR was developed as a research platform with a compact body that has both capabilities and safety for field tests in home environments.

2 DESIGN

The basic specifications of HSR are shown in Table 1. The robot as a whole has 8 DoF combining the 3 DoF of the mobile base, 4 DoF of the arm and 1 DoF of the torso lift. Thus, it is possible to generate flexible movement by moving the carriage and the arm together(Fig. 3). Various sensors are installed for the ease of use as a research platform.

HSR's software architeture is built on ROS(Robot Operating System)[Quigley et al. 2009], which is widely used among robotics reseachers. This enables reseachers easily start to use HSR.

Table 1: hsr basic specifications

size	ϕ430×1,005(~1,350)mm
weight	37kg
arm length	600mm
shoulder height	340~1,030mm
grasped object	~1.2kg weight ~130mm width
maximum velocity	0.8km/h
off-road performance	~5mm difference in level ~5deg slope

Figure 3: HSR's various movement patterns.

3 RESEACH PLATFORM

In recent years, international robot competitions attract attentions as an effective approach to accelerate research and development of robots [ROB [n. d.]][DRC [n. d.]][WRS [n. d.]]. HSR was adopted as the Standard Platform for RoboCup@Home from the six candidates who passed the document selection under the review of the RoboCup International Committee in 2016[ROB 2016]. HSR was used at the Domestic Standard Platform League (DSPL) for home service robots since RoboCup 2017 Nagoya. Moreover, it has been adopted as a standard platform for the service robot competition of the World Robot Summit (WRS)[WRS [n. d.]] which is scheduled to be held in 2020 in Japan after the Tokyo Olympic Games. Given these facts, it seems that HSR got popularity in robot competitions. HSR was provided to 33 universities and companies in 8 countries through public offerings as of February 15th 2017, and research and development is proceeding in each projects.

4 CONCLUSIONS

In this paper, we described HSR's development objective, design and its utilization. We expect that this paper provides useful information for the current and prospective researchers. We think the design of HSR is still under active development and we will improve it reflecting users' requests continuously. HSR public offerings and openings for collaborative research will be scheduled at all times. We will welcome the new researchers to collaborate with HSR Developers Community.

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