# Telewheelchair: The Intelligent Electric Wheelchair System Towards Human-Machine Combined Environmental Supports


Ippei Suzuki*
University of Tsukuba
1heisuzuki@gmail.com

Satoshi Hashizume*
University of Tsukuba
pota1401@hotmail.co.jp

Kazuki Takazawa*
University of Tsukuba
1220kazu1412@gmail.com

Ryuichiro Sasaki
AISIN Seiki Co.,Ltd.
ryu-sasa@nbd.aisin.co.jp

Yoshikuni Hashimoto
AISIN Seiki Co.,Ltd.
hassy@its.aisin.co.jp

Yoichi Ochiai
University of Tsukuba
wizard@slis.tsukuba.ac.jp



**Figure 1: Left: The Telewheelchair. Center: Usage scene in the library. Right: System overview.**


## CCS CONCEPTS

**•Human-centered computing →Virtual reality;**

## KEYWORDS

Telepresence, virtual reality, nursing.

**ACM Reference format:**
Ippei Suzuki, Satoshi Hashizume, Kazuki Takazawa, Ryuichiro Sasaki, Yoshikuni Hashimoto, and Yoichi Ochiai. 2017. Telewheelchair: The Intelligent Electric Wheelchair System Towards Human-Machine Combined Environmental Supports. In *Proceedings of SIGGRAPH '17 Posters, Los Angeles, CA, USA, July 30 - August 03, 2017,* 1 pages.
DOI: 10.1145/3102163.3102238


## 1 INTRODUCTION

In this paper, we propose a telepresence system that is able to provide care from a remote location by implementing functions such as object recognition on a wheelchair (Figure 1 Left). In conventional remote control robots, the operator controls the system while receiving feedback from cameras mounted on the robot [Gundersen et al. 1996]. However, this operating method cannot capture the full environment around the system, even if we use wide FOV cameras, such as omnidirectional cameras. This leaves the operator with incomplete feedback. In order to utilize the telepresence system safely, it is necessary to solve the problem of the blind spot of the user. Further, human operators are limited by their attention span. The reaction time of the computer is greater than that of humans.

In this study, we implemented a telepresence system based on the head mounted display (HMD), object recognition by YOLO [Redmon et al. 2016], and environment recognition by SLAM [Caruso et al. 2015] to an electric wheelchair; this system allows the detection of the condition around the wheelchair and the presence of pedestrians close to the wheelchair. It is also possible for the remote operator to communicate with person(s) near the wheelchair via a camera, microphone, and speaker mounted on it.

## 2 IMPLEMENTATION

Figure 1 (Right) shows an overview of our system. The system is divided into two parts: the electric wheelchair unit and base station for remote operation. The electric wheelchair has an omnidirectional camera and HDMI wireless transmission device for transmitting live images to the base station. The base station is comprised of three desktops, and it is used for HMD control, object detection by YOLO, and environment recognition by SLAM. The video transmitted from the omnidirectional camera (Theta S; Ricoh Company, Ltd.) mounted on the wheelchair is distributed to three computers by the HDMI splitter. The remote operator wears the HMD and operates the wheelchair with the controller. The wheelchair will stop when an obstacle such as a pedestrian is detected in the surrounding by environment recognition by YOLO and SLAM. The remote operator and the wheelchair user are able to switch control actively.

## REFERENCES


D. Caruso, J. Engel, and D. Cremers. 2015. Large-scale direct SLAM for omnidirectional cameras. In *2015 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*. 141–148. DOI : http://dx.doi.org/10.1109/IROS.2015.7353366

RT Gundersen, Stephen J Smith, and Ben A Abbott. 1996. Applications of virtual reality technology to wheelchair remote steering systems. In *Proc. of 1st Euro Conf of Disability, Virtual Reality & Assoc. Technology*. 47–56.

J. Redmon, S. Divvala, R. Girshick, and A. Farhadi. 2016. You Only Look Once: Unified, Real-Time Object Detection. In *2016 IEEE Conference on Computer Vision and Pattern Recognition (CVPR)*. 779–788. DOI : http://dx.doi.org/10.1109/CVPR.2016.91


* Three joint first authorship.


*SIGGRAPH '17 Posters, Los Angeles, CA, USA*