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Human-Robot Communication for Surveillance of Elderly People in Remote Distance

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Abstract

In this paper, we present a tele-operated mobile robot system for old age surveillance. The robot operates in autonomous mode in which the robots navigates in the environment and search for unusual situation of elderly people. If a patient is lying on the floor, the robot informs the user. The user switches the control mode from autonomous to haptic based user control. In the autonomous mode, the robot utilizes the visual sensor and landmarks to monitor the entire environment. The robot is equipped microphone, speaker and monitor making it possible to communicate with the user in remote place. In addition, the robot utilizes the vital sensors to check the patient's condition. The preliminary surveillance experiments show a good performance.

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1. Introduction

Recently, Japan is rapidly going to an aging society, and in 2015 the elderly population will make up 26.8% of the total, or one out of four people will be a senior person [1]. Simultaneously, the number of home

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and/or visiting care service facilities is increasing. The care service utilization factor is more than 90%. On the other hand the number of staff working in these facilities is not sufficient. It has caused the increasing of work load per person resulting in a very tiring job and low quality of care service. Therefore, application of autonomous robots to replace staff work is highly required.

Development of robots for surveillance of elderly people has been presented in previous research works. For example, Matsui et al. [2] developed a noncontact vital data monitoring system using microwaves for bedridden old men. Oda et al. [3] developed a watching system for the elderly in room using image processing and sensor embedded bed. However, these systems are available only in a single room, making it expensive to be implemented in whole facility. On the other, Sawashima et al. [4] developed elderly people monitoring system in care house using a mobile robot. The robot system can move from room to room autonomously. However, in an emergency which the elderly lying down, the robot can't approach to check their consciousness and vital conditions.

In this work, we propose a tele-operated mobile robot system for old age surveillance. Our system is operated under the LAN/Internet environment in the facility. The robot surveys the environment autonomously. In addition, the operator can grasp the remote environment using the robot camera image. When the robot finds a patient lying on the floor, the robot notices an alert to the operator, and then changes to the manual operation mode, automatically. In the manual mode, the operator can communicate with the patient via an interactive user interface, and check his vital conditions using the sensors attached to the robot. The preliminary surveillance experiments show a good performance.

2. Developed System

Fig.1 shows a schematic diagram of our developed system. The operational target facility is a hospital or care house under the LAN/Internet environment. The robot surveys along a corridor and room autonomously by collecting and processing the environment information. The operator can monitor in real time the environment, and communicates with a patient or elderly as needed. In an emergency, when a patient is lying on the floor, the robot informs the operator. The operator controls the robot in the manual mode using the haptic device.

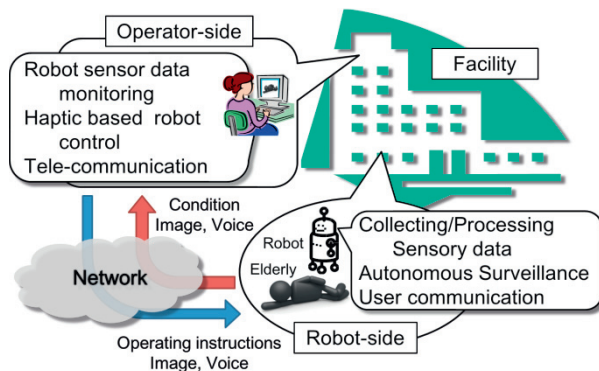


Fig.1 Schematic diagram of developed system.

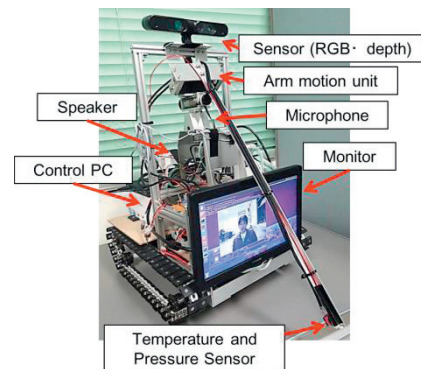


Fig.2 Surveillance Robot

2.1. Surveillance Robot

The developed surveillance robot is shown in Fig.2. The robot has a depth/RGB image sensor (Xtion Pro LIVE, ASUS) and a arm equipped a temperature sensor and a pressure sensors. In addition, the robot has a

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