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Remote Monitoring Service Robot Platform for an Intelligent Surveillance System

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Abstract. Remote monitoring service robot platforms can be applied to surveillance systems when the service robot has the appropriate features, e.g. a camera, microphone, and wireless communication. This paper presents a prototype of a service robot platform as an intelligent surveillance system for child monitoring. In order to achieve the purpose of this research, a server-client based control scheme between multiple users and remote service robots is developed, as well as an appropriate communication method. The experimental results demonstrate the feasibility of the proposed service robot platform through integrating these skills into the prototype service robot platform as an intelligent surveillance system for childcare.

Keywords: Service Robot, Childcare, Surveillance System, Remote Controlled Mobile Robot

1 Introduction

Recently, child abuse at home and in childcare centers has become a critical social issue. As a result, mandatory static closed circuit television (CCTV) systems are increasingly being installed in daycare centers and kindergartens. However, conventional CCTV camera systems have a issues with blind spots; therefore, a remote monitoring platform using a web camera installed in the service robot could be a good solution for a remote child monitoring system [1].

This paper proposes a prototype of service robot platform as a next-generation intelligent surveillance system for child monitoring. A server-client based control scheme between multiple users and a remote robot is proposed with an appropriate communication method.

In this paper, a service robot platform is proposed for a surveillance system for specific use in childcare centers; the platform consists of the deployment of multiple service robots in separate caring facilities, smart devices for remote parents and teachers, and a surveillance server. The surveillance server manages the remote monitoring image streams captured from each robot, the bi-directional voice streams of the robot, and the smart device for communicating among the devices. It also enables control of the command messages from the users' smart devices to multiple

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robots simultaneously, while the smart devices and robots are connected through a network environment.

In this system, it is considered that each service robot is connected to the server through a network system using a wireless access point (AP), and the smart devices are connected to the server through 3G, 4G, or Wi-Fi networks. In addition, after developing the application software as a client for users to monitor the remote situation and control the service robot, an experiment was conducted that demonstrates that smart device can control the service robot over a remote connection to the server via a network environment using Wi-Fi and cellular networks.

The effectiveness of the proposed service robot platform is demonstrated through the results of an experiment conducted in separate spaces for a robot in an indoor environment and for a user in a remote location.

2 Surveillance System with Multiple Robots and Remote Clients

An intelligent surveillance system with two or more mobile robots that have cameras, microphones, and speakers is proposed, and the robots are placed in separate childcare centers. The remote surveillance server handles the images, voice data, and control messages from multiple robots that are connected to the server in a network environment via Wi-Fi APs. It is considered that the server has a fixed IP located in an internet data center (IDC) for secured multiple remote monitoring.

In addition, Android-based application client software was designed for smart devices to access the server and to select the appropriate facility to be monitored after the server-client connection has been made [2]. The smart device client provides remote monitoring of the selected facility and a control interface.

The server must manage massive data and control the message processing from multiple robots and application clients; therefore, the surveillance system is designed with one server and two sets of clients, i.e. the robot and smart device. Figure 1 presents an overview of the proposed intelligent surveillance system with multiple robots and clients.

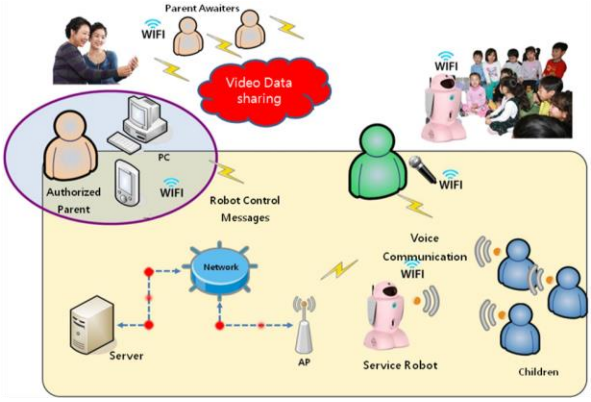

Fig. 1. Overview of the proposed surveillance system with multiple robots and remote clients.

The service robot platform used in this research was developed under a joint development research program between Mokwon University and CNRobot Inc. [3]. Figure 2 presents the appearance and specifications of the service robot. The robot has two wheels, a pan/tilt mechanism, embedded board-based camera, a microphone, and speakers. It can move and capture images and voice data, and send those to the remote server over a Wi-Fi network.

A method to transfer the robot control rights is needed when many users want to use one service robot while they are monitoring the same remote scene. In the process of transferring the robot control rights for remote robot control and communication, the transfer waiting time and alarms are displayed differently to the control applicants and access waiting clients. Therefore, the inconvenience in the process of waiting can be reduced and their service use time can be predicted in advance.

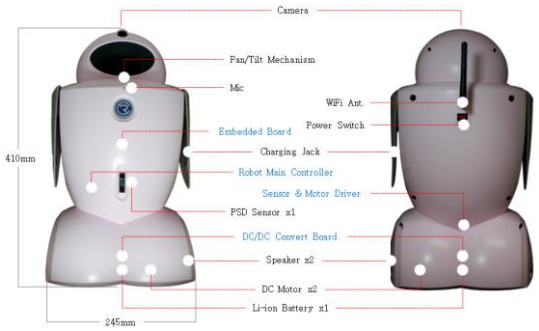

Fig. 2. Appearance and specifications of the service robot.

3 Experimental Results

The server was implemented using C# language in a general Windows-based operating system environment, and then the data communication with PC and smart device-based client applications was tested [4, 5]. The server can conduct management functions such as connection with the robot and the clients, display of the robot and server status, transfer of images and voice data from robots to the specified clients, and transfer of control messages to the robots as shown in Figure 3.

Fig. 3. Demonstration of the robot motion through server linkage.

4 Conclusion

This paper presented the technology of obtaining and displaying mobile robot remote monitoring of images and voice data in selected remote spaces, and robot access technology through selecting specific facilities to be monitored after accessing the server through the application client. The experimental result demonstrated that the proposed system performs successfully in remote monitoring and control of multiple service robots with multiple clients in a network environment. Finally, the feasibility and effectiveness of the proposed system has been successfully demonstrated for future intelligent surveillance systems in childcare centers or at home.

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