A Proposal of Intuitive Home Appliance Control System Based on Its Position Information

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***Abstract*—Intelligent home appliances that can be controlled via a network are spreading widely, and expected to increase more. However, when a user wants to control an intelligent home appliance, it is difficult to distinguish the appliance clearly from other appliances in the house only by obtainable model numbers. Moreover, there are several communication standards for intelligent home appliances, such as DLNA and ECHONET Lite. Therefore, the user must use controller applications properly according to each appliance. This paper proposes an intuitive Home Appliance Control (iHAC) system that can control appliances intuitively by adding position information of them without considering differences in communication protocols. We develop a prototype iHAC application for iPad and confirm whether position information attached to appliances is valid.**

I. Introduction

With the widespread use of mobile devices and the Internet, intelligent home appliances have become popular. A user can control these appliances easily with a smartphone and a tablet. However, when the user wants to operate an intelligent home appliance, it is difficult to select properly the appliance that the user wants to operate and to distinguish clearly appliances having the same or similar model numbers in the house. Because the user can acquire only character information such as a model number of them first at the beginning of an operation start. Moreover, there are several communication standards for intelligent home appliances, such as Digital Living Network Alliance (DLNA) and ECHONET Lite. The user must use controller applications properly according to each appliance.

As a method for unitedly handling differences in protocols, the cooperative system of heterogeneous protocol using Peer-to-peer Universal Computing Consortium (PUCC) Protocol has been proposed [1]. The system requires a home gateway (HGW) which implemented PUCC protocol. Therefore, a PUCC system cannot be lightly tried and used by anybody.

This paper proposes an intuitive Home Appliance Control (iHAC) system that can control appliances intuitively without both considering differences in communication protocols and introducing a special device. In iHAC system, position information associated with appliances to enable a user to determine the appliance easily. In this paper, we evaluate the effect of position information on the improvement in operability of appliance control.

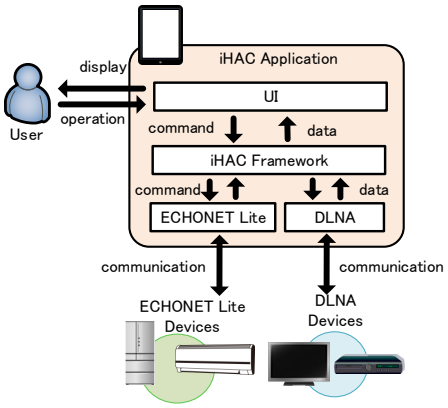

Fig. 1. Configuration of the proposed system.

II. Proposed System

Fig. 1 shows the configuration of iHAC system. The iHAC system comprises a tablet device with an iHAC application which works as a controller and commercially available intelligent home appliances. The iHAC application is a three-layerd structure composed of a user interface (UI) layer, an iHAC framework layer and a communication processing layer.

The UI layer displays the information or a menu for the operation of appliances. This layer calls APIs defined in the iHAC framework in accordance with the operation of a user.

The iHAC framework layer absorbs difference between communication protocols that differ from each appliances. The iHAC framework provides APIs that are related to appliance control and acquisition of appliance information to the UI layer. These APIs call other related functions or methods provided in each communication library such as DLNA and ECHONET Lite in the communication processing layer. The framework also shapes the obtained data of each communication library into a unified format and adds the position information to responses from each communication library. Moreover, the framework has database which holds device names and identifiers of discovered appliances, position information associated with each appliances, and its device types, such as a TV and an air conditioning.

For example, the user tap the ”Search Devices” button on the

iHAC application, the iHAC framework discovers surrounding DLNA and ECHONET Lite appliances simultaneously, and then device names of discovered appliances are classified in each position information and displayed as a list. Therefore, the user can intuitively and quickly select an appliance which the user wants to operate.

III. Implementation

We developed a prototype iHAC application running on iPad and implemented the search API, the registration API, the service list acquisition API and the service execution API to the iHAC framework. The search API searches for appliances connected to the network and returns discovered appliances information with its position information. The data format as JSON format. The registration API registers a designated appliance to a database in association with position information that the user specified. The service list acquisition API acquires types of executable services in the designated appliance, such as a power on/off operation and a playback of content. The service execution API executes the designated processing. Some of these APIs calls functions defined at a communication library in the communication processing layer. In this prototype iHAC application, the communication processing layer is partially implemented. The communication layer has only a DLNA library, namely Platinum UPnP SDK provided by Plutinosoft.

IV. Evaluation

A. Experiment

In order to verify the effects of adding position information during operating appliances, we measure the operation time and the number of taps for the operation of applications that required from the start of searching appliances to the playback of the specified photo. Subjects use iHAC applications with and without position information. We investigate changes of the operation time and the number of taps at that time.

In the experiment, we used five Digital Media Servers (DMSs) that are DLNA appliances holding the content and a Digital Media Renderer (DMR) that is DLNA appliance having a function of playing content. We installed three DMSs (QNAP-NAS, BDZ-EW1100 and BDZ-EW1200) in a living room, two DMSs (TwonkuMedia [QNAP-NAS] and BDZ-EW1200) in a bedroom and one DMR (BRAVIA KDL-32W700B) in the living room. Fig. 2 shows the search result displayed in the iHAC application.

We instructed ten subjects to playback the photo stored in BDZ-EW1200 installed at the living room on BRAVIA KDL-32W700 installed at same room. Before beginning this experiment, we explained which appliances were installed in each room to subjects.

B. Measurement result

Fig. 3 shows the comparison of the average number of taps and the average operation time with and without position information. The average number of taps is 11 times when

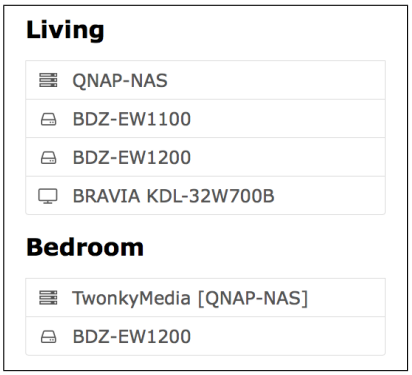

Fig. 2. Device search result of iHAC application grouped based on position information.

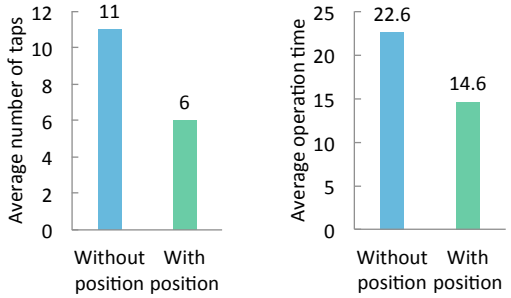

Fig. 3. Average number of taps and average operation time with and without position information.

subjects used the iHAC application without position information. On the other hand, when they used the application with position information, the average number of taps is 6 times. Moreover, the average operation times are 22.6 seconds without position information and 14.6 seconds with position information respectively. In other words, we were able to decrease 45.5% in the average number of taps and 35.5% in the average time. As the results, we confirmed that position information can help the user to operate intelligent home appliances intuitively and quickly.

V. Conclusion

This paper proposed the iHAC system that can control intelligent home appliances intuitively even if several appliances of different communication standards coexist. Through the experiment, we confirmed that position information are effective for operating intelligent home appliances intuitively and quickly.

VI. Acknowledgment

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References

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