Smartphone-Based Microphone: A Multi-User Service for Collaborative Work

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***Abstract*—SmartRoom is a smart space-based system for assisting such collaboration activity as a conference or a meeting. The assistance is in the form of digital services provided to the users, having personal mobile devices (e.g., smartphone), in a multimedia-equipped room. In this work, we continue our development of microphone service, which allows a SmartRoom user to exploit her/his smartphone as a microphone wirelessly linked with an audio system in the room. The service supports new scenarios for voice communication between a current speaker and other participants. In the considered case study, the client part is implemented for Android mobile devices.**

SmartRoom system [1] provides digital information services for assisting such collaborative work as conferences and meetings in a multimedia-equipped room. To access services a user can exploit her/his own personal mobile device (such as smartphone) where SmartRoom client is running [2]. The SmartRoom development uses the smart spaces approach, and the Smart-M3 platform is used as underlying technology and middleware [3].

With Microphone-service [4] a SmartRoom user can speak to the microphone built in her/his smartphone. The voice is transferred to the audio system of the room and all participants can hear the speaker. There is no need in special microphone equipment, which the participants and organizers need to exchange, as it happens in traditional conference rooms.

We continue our development of Microphone-service. We implemented a multi-user support for collaborative work when the participants can use such an exclusive resource as the audio system in the room. The basic application scope is as follows (for the conference mode of SmartRoom).

1) The speaker uses Microphone-service when presenting her/his slides.
2) The chairman uses Microphone-service when managing the discussion of the talk.
3) Other participants use Microphone-service when asking questions or providing comments.
4) The speaker uses Microphone-service to answer the questions.

As a result, the service makes communication of the participants easier (or “smarter”).

The key development issue is mutual exclusion: at most one participant may use the audio system at the same time. At the recent development phase, we experiment with Android smartphones, while the same approach can be applied for other mobile operating systems and personal mobile devices.

Microphone-service controls audio data stream. Audio packets generated by user’s speech are sent from mobile device connected to service through Wi-Fi. Received data played on audio system connected to computer. SmartM3 Semantic Information Broker (SIB) provides read&write access to the shared knowledge. The architectural scheme is shown in Fig. 1.

The service scenario is shown in Fig. 2. A participant listens some report by the speaker. If she/he has a question then clicks ”Ask Button” (1) in the SmartRoom client. The registered username appears in ”Queue List” (2) with the usernames of other participants waiting for the service to ask some question. For the first user in ”Queue List” the microphone tab can be opened (3), which starts transmitting user’s voice to the audio system. This participant can tell something to the microphone, sitting on her/his place and not

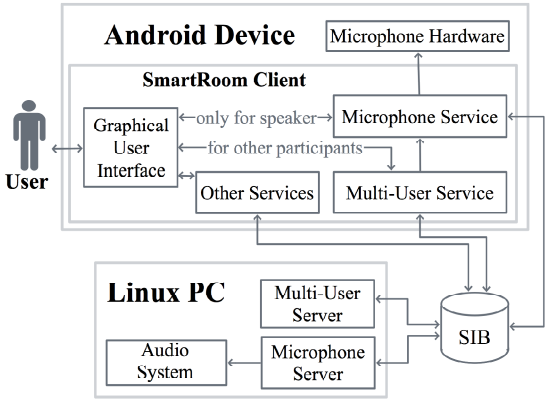

Fig. 1. Architectural scheme

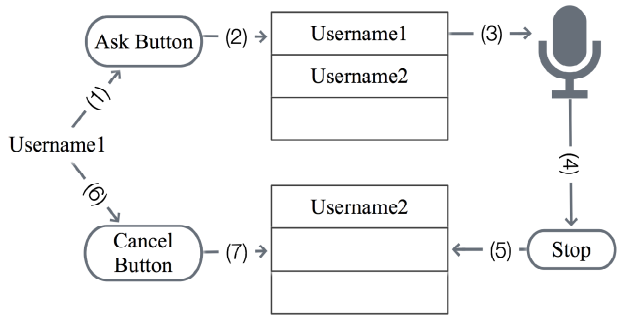

Fig. 2. Scenario of multi-user Microphone-service

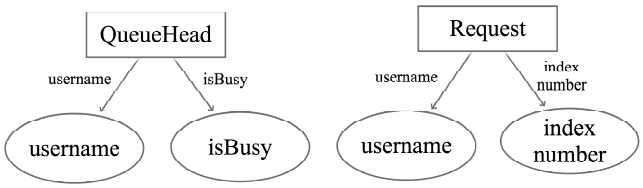

Fig. 3. Basic ontology classes for the service

TABLE I. CODE METRICS.

Files	Number of code strings
QueueService.java	56
QueueListActivity.java	203
QueueActivity.java	181
MicActivity.java	137
Kp.c	314
QueueServer.c	389

using a special microphone equipment. When the participant has finished (4), the username disappears from ”Queue List”, and the next username in the list becomes the first one (5). If a participant is waiting in the queue then she/he can anytime click ”Cancel Button” to skip the service (6), and the username disappears from ”Queue List” (7).

An ontology is used to describe the shared information and its semantics in the SmartRoom smart space [1]. In particular, the ontology defines how the shared information is related to different services and users. The service representation follows the ontology depicted in Fig. 3. There are several classes. ”Request” has username of the participant, who has clicked ”Ask Button”, and her/his sequence number. ”Queue Head” has the username of first user in ”Queue List” and the audio system occupancy status.

The algorithms to implement mutual exclusion for the service with multi-user access are shown in Fig. 4. The Smart-M3 subscription operation is used for tracking changes in a specified part of the shared information [5]. The mobile client waits for appearance of a new ”Request” individual with the username of the participant. When the client has received such a new individual then the client sets the username from the ”Request” individual to the ”Queue Head” individual. Microphone-service becomes ready for use when the username of ”Request” and the username of ”Queue Head” are identical.

The service is primarily implemented using SmartSlog SDK [6]. SmartSlog supports ontology-driven development in ANSI C. The server part is a Smart-M3 knowledge processor (KP) running on a dedicated computer. The client part also uses SmartSlog since Android supports native code, while the user interface is written in Java, see the programming approach in [7]. Code metrics of the implemented prototype (server and client parts) are summarized in Table I.

The presented implementation expands the previous version of Microphone-service. Now the service can be used in multi-user settings when the audio system has to be preserved as a resource with mutual exclusion [8].

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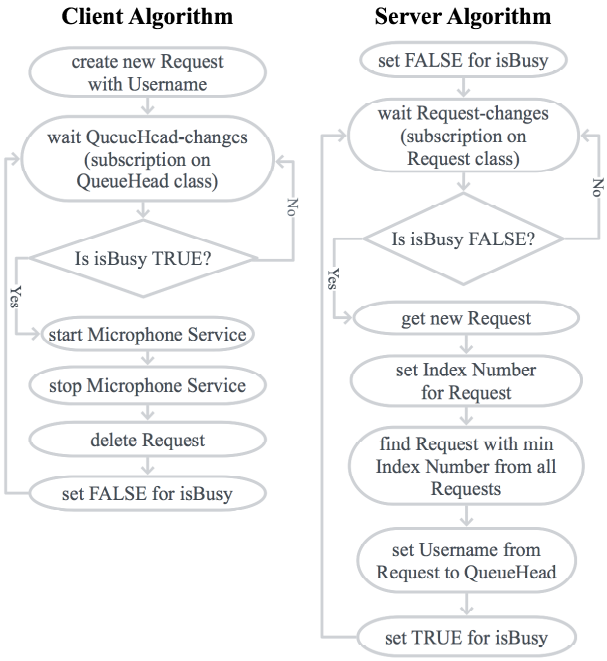

Fig. 4. Algorithms of mutual exclusion

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