HomeOrgel: Interactive music box to present actual home activities with symbolic sounds

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Abstract. We propose a music-box-type interface, “HomeOrgel”, which can express various activities in the home using sound. Users can also control the volume and content using common methods for controlling a music box: opening the cover and winding the spring. This system helps users look back on past activities in the home using sounds, imitating the recall of memories using a music box. We developed the HomeOrgel device and installed a simple activity recognition system in an actual house "Ocha House" to verify the effectiveness of the HomeOrgel using actual data.

Keywords: Auditory display, music box, ubiquitous computing, smart home.

1 Introduction

In the near future, it will be common for a large number of computers and sensors to be installed in the home. There have been many research projects on the design of smart homes as test-beds for new technologies in a future environment. While most projects focused on activity recognition, representation methods of these activities have also attracted attention in recent years [1,6]. To design such representation systems, we need to consider emotional factors: for example, when a user wants to know the status of his/her family member, the presentation method using a picture of the family member [4] is more comforting than a text presentation such as email. We focused on a music box to present home activities because the music box is familiar to most people, particularly when they look back on their memories. We propose an auditory interface modeled on a music box, “HomeOrgel”, which helps users look back on past activities in the home using sounds, imitating the recall of memories using a music box.

2 HomeOrgel

The HomeOrgel presents various activities in the home using sounds. Users can control the HomeOrgel using common methods for controlling a music box: when a user

winds the spring and opens the cover, he/she can hear the sounds of home activities with the background music (BGM) mechanism of the music box. The user can easily perceive the home activities by listening to these sounds in the same manner as listening to music from a common music box (**Fig. 1**).

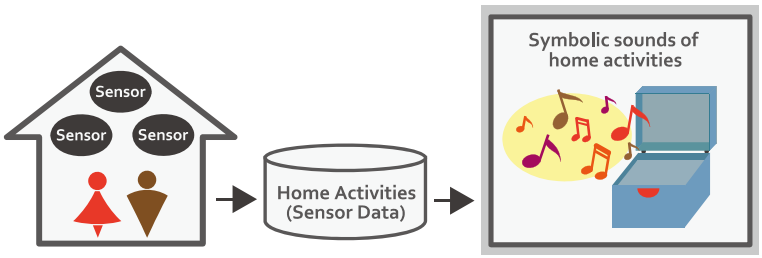

Fig. 1. Concept of the HomeOrgel

. The HomeOrgel provides three main interactions similar to general music boxes by simply using the cover and spring as shown in **Fig. 2** (Left) . The procedures are as follows:

1. The user winds the spring on the back of the HomeOrgel by a half-turn.
2. When the user opens the cover, the HomeOrgel starts to play BGM and sounds of past activities (e.g., from 1 hour ago).
3. Sounds of past activities are compressed into a certain length (e.g., 20 sec).
4. The user can change the volume by adjusting the angle of the cover: the volume is increased (decreased) according to the degree to which the cover is opened (closed).
5. When the user closes the cover, the music stops.

When the user winds the spring through more cycles, the HomeOrgel will play the sounds of activities further back in the past. For example, when the user winds the spring three times, he/she can hear sounds of home activities for the past 3 hours. These sounds are compressed into short length to help users look back on past activities more effectively. We developed a HomeOrgel prototype with the above features. The HomeOrgel device consists of several sensors and a speaker in a ready-made music box as shown in **Fig. 2** (Right).

The HomeOrgel helps users recognize the meaning of sounds using pre-recorded “symbolic sounds” corresponding to home activities. For example, when someone opens/closes an entrance door in the home, the HomeOrgel plays the sound of a door opening/closing (e.g., “bang").

Lastly, we introduce one scenario using the HomeOrgel: a father living away from his family comes home at midnight every day since he is quite busy at his business, meaning he cannot call his family as often he wants. One midnight, he thinks about his family and uses the HomeOrgel. He opens the cover after winding the spring. He can catch up with the activities of his family by hearing the music on the HomeOrgel:

his children left home in the morning; his wife cooked before children came home. This allows the father to feel at ease.

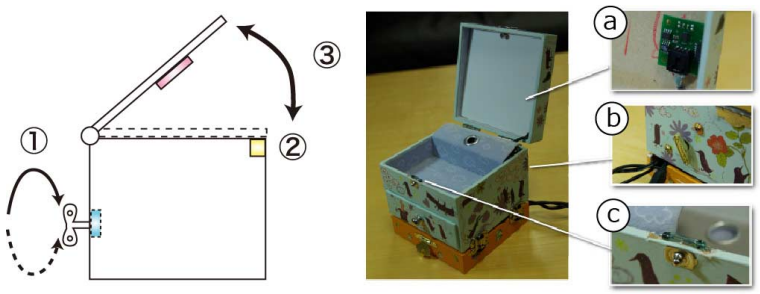

Fig. 2. Usage of the HomeOrgel (Left): (1) winding a spring to rewind to past activities, (2) opening/closing the cover to play/stop music, and (3) adjusting the tilt of the cover to control volume, Implementation of the HomeOrgel (Right) : (a) acceleration sensor, (b) knob with a rotation sensor, (c)bottom right: magnetic sensor.

3 System installation

We installed a simple activity recognition system in an actual house "OchaHouse[1]" to verify the effectiveness of the HomeOrgel using actual data.

First, we explain the installation of wireless sensor modules in Ocha House. Each module consists of a wireless communication module (Digi International XBee[2]) and a human detection sensor (Panasonic Electric Works NaPiOn) to detect user movements. We installed the sensor modules in various locations in Ocha House, including the entrance, passage, kitchen, dining room, living room, bedroom and bathroom (**Fig. 3**). Next, we developed two types of middleware, "XBeeServer" and "OchaHouseManager", to control the above sensor modules. The XBeeServer collects sensor data from XBee modules (XBeeEndPoints) and translates them into simple messages. The OchaHouseManager receives these messages from the XBeeServer via TCP Sockets and converts them into location/status parameters (e.g., living room/motion, entrance/open) and saves them to the database (Microsoft SQL Server).

The HomeOrgel software determines the recall period by the number of times the spring is wound and extracts the relevant past data from the database. The HomeOrgel estimates the activity (or "event") from the detection areas of sensors.

We will evaluate the performance of the HomeOrgel using these systems.

[1] Ocha House: an experimental smart house for evaluating ubiquitous computing applications.
[2] XBee: a wireless communication module based on the 802.15.4/ZigBee standard.

4 Related works

There have been several research projects that represent home activities. Digital family portrait [4] provides qualitative visualizations of a family member's daily life. Leveraging a familiar household object, the picture frame, this system populates the frame with iconic imagery summarizing for several weeks. The ambientROOM [3] is an interface to information for processing in the background of awareness. Bottles[2] is an interface to access digital information using glass bottles as "containers" and "controls". Music Monitor [5] illustrated how music can be used to balance attention between two active rooms in a home, with an initial focus between the kitchen and living room. InPhase [6] proposed a new method of communicating the "happy coincidences" between a pair of remote locations using sounds. The HomeOrgel represents a wide range of activities in the home using symbolic sounds. Moreover, a user can understand most activities simply by listening to the corresponding sounds without any advance study of the mapping. Additionally, our system can help users look back on past activities easily using techniques common to the control of a music box.

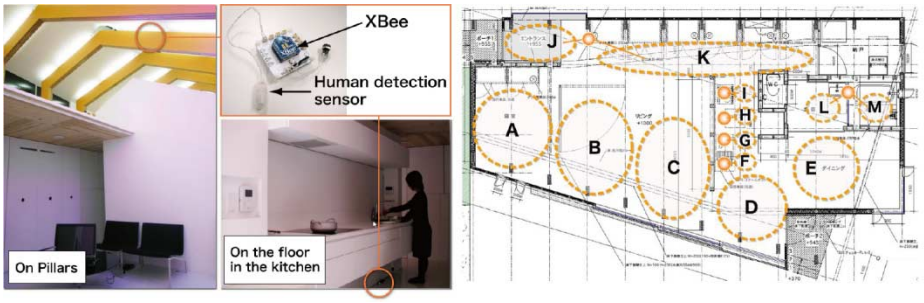

Fig. 3. Left: Installation of wireless sensor modules in "Ocha House".
Right: all sensor module detection areas.

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