An Interactive Musical Installation through Spatial Sensing

Takuya Yamauchi
Graduate School of Media and Governance
Keio University SFC
5322 Endo, Fujisawa 252-8520 Japan
yamauchi@sfc.keio.ac.jp

Toru Iwatake
Graduate School of Media and Governance
Keio University SFC
5322 Endo, Fujisawa 252-8520 Japan
iwatake@sfc.keio.ac.jp

ABSTRACT

This paper describes a sound installation work supported by spatial sensing system with a Personal Area Network (PAN), which may be applicable for such areas as dance performances and mobile music. The introduction section surveys some of spatial technologies that track moving objects and identify these agents. The system design section describes the architecture that makes use of MAX/MSP application. The actual installation is supported by the system.

1. INTRODUCTION

When we consider emerging human behaviors in a new audio-visual space with PAN or WAN, it becomes important to consider the social contexts.

1.1 Technological Survey

Video tracking is one of the most popular technologies for detecting objects in PAN. It is used with dance performance projects [1, 2]. The technology uses differential equation to detect reflective markers on moving objects.

GPS is used for searching agents in WAN. Some musical and visual installations use GPS equipped mobile phones [3, 4].

Multi sensors system is capable of tracing human's behavior. In such a system, the sensors in the floor, walls, and ceilings in a room are connected, and communicate to each other the tracing information.

1.2 Social Contexts

When we consider the social contexts of special technologies, it is important to point out GPS. Because the use of cell phones has been wide spread, phones with GPS are not only able to give spatial information to the users, but also the knowledge of the social context they are in since most of cell phones can get access to the internet [5].

In this paper however, we used supersonic sensors with PAN and developed a simple example of localization system that can be applied to a musical installation.

4th International Mobile Music Workshop, May 6–8, 2007, Amsterdam, The Netherlands.

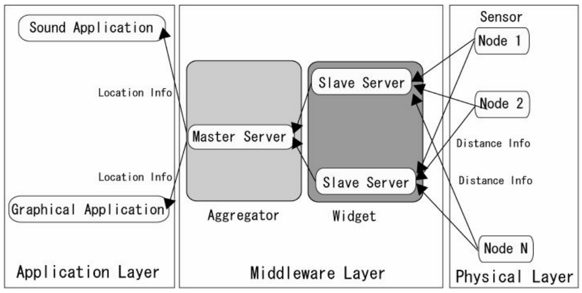

Figure 1. Location System Architecture

2. SYSTEM ARCHITECTURE

Fig. 1 shows the system architecture. Software implementations can be classified into two groups. One is an embedded system, which is often associated with commercial games, and the other is a GUI-based software language. Embedded implementations consist of various libraries; each library must be designed/maintained separately which is not cost effective. But GUI-based software languages such as "MAX/MSP" are cost effective and flexible. Therefore we implemented a real-time positioning system using a GUI-based software language.

The system consists of a physical layer, a middleware layer, and an application layer. The middleware system design was based on a widget integrated framework (WIF) [6]. After the widget on the slave server collects the location information it is sent to the aggregator on the master server using the open sound control (OSC) protocol [7]. The aggregator estimates the relative distance and the location information of the moving people by interpreting the real-time widget data.

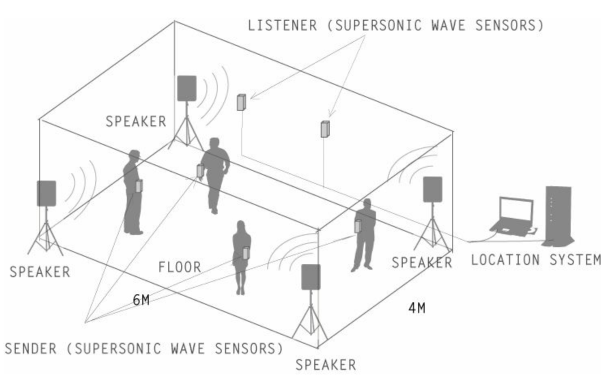

Figure 2. Localization System

3. INSTALLATION

3.1 Sound Jewelry

The term "Sound Jewelry" was coined by Iwatake, one of the authors of this paper. The original idea is to create interactive musical objects that are worn like necklaces by people. Each of the "Sound Jewelry" then automatically generates "melody" and according to the distance between the persons wearing it the sounds of "melodies" may be changed or exchanged. On the other hand, Yamauchi, the first author, has been researching into real-time localization systems for multiple agents in a PAN. So it was only natural for the two ideas come together.

Fig. 2 shows the localization system. There are two "listeners" on the wall and eight "senders" to be held by the participants. The "senders" transmit supersonic waves to the "listeners", and the master server which is connected to the "listeners" measures the locations of the "senders" based on the distance estimation subroutine in the middleware. The results are sent using OSC protocols to the sound generating application, whose outputs are heard from 4 surrounding speakers in the environment.

The actual "Sound Jewelry" turned out to be an environment that consists of two layers of sounds. In the foreground, "melodies" are dynamically generated by measuring the distances between the participants. In the background, ambient sounds are automatically generated using the distance data. When many people move in a 4X6 m2 space, the sound only changes based on the nearest relative distance. However, as the number of people increases, the sound changes become more complex. Sound complexity was used as part of the installation. Users recognized sound changes as they moved in real time in the space.

4. CONCLUSION AND FUTURE WORK

Figure 3. Sound Jewelry

The picture above shows the "Sound Jewelry" installation. People with "senders" walked around the floor in a location system zone and they recognized the changes of sounds according to the relative distance between them.

Table 1 shows the number of users that recognized the changes of sounds at the relative distance. The percentage of the total users is also shown. Most users recognized the existence of nearest user at the distance of 2 meters, and most users recognized changes of sounds at a distance of between 1 and 1.5 meters. However, obstacles that could cause interference in the location system zone need to be considered. The system assumed that obstacles did not exist in the zone. Naturally, it is difficult to use the system in a cluttered or crowded room. To solve this problem, a hybrid system that is equipped with wireless LAN, Bluetooth, or RFID readers can be considered to estimate the user's position correctly. Furthermore, the system needs to be adaptable to many different software languages. We assumed that a WIF can be used to implement the system. However, in the near future, we would like to consider new frameworks.

	>3m	2-1m	1m-50cm	50-30cm	<30cm	N/A
Sound recognition distance	0	6	9	7	1	2
Percentage	0	24%	36%	28%	4%	8%

Table 1. Sound Recognition Distance and Percentages

5. ACKNOWLEDGMENTS

This project is supported in part by a grant from CREST, JST. We would like to thank the members of CREST for their helpful suggestions.

6. REFERENCES

[1] James, J., Ingalls, T., Qian, G., Olson, L., Whiteley, D., Wong, S., and Rikakis, T. Movement-Based Interactive Dance Performance. In *Proc. of ACM Multimedia'06*, Santa Barbara, CA, USA, 2006.

[2] Wakkary, R., Hatala, M., Lovell, R., and Droumeva, M. An Ambient Intelligence Platform for Physical Play. In *Proc. of ACM Multimedia'05*, Singapore, 2005.

[3] Gemeinboeck, P., Tanaka, A., Dong, A. Instant archaeologies: digital lenses to probe and to perforate the urban fabric. In *Proc. of ACM Multimedia'06*, Santa Barbara, CA, USA, 2006.

[4] Carter, W., Liu, L. S. Location33: Envisioning Post iPodalyptic Mobile Music. In *Proc. of 2nd International Workshop on Mobile Music Technology*, NIME'05, Vancouver, Canada, 2005.

[5] Behrendt, F. From calling a could to finding the missing track: Artistic approaches to mobile music. In *Proc. of 2nd International Workshop on Mobile Music Technology*, NIME'05, Vancouver, Canada, 2005.

[6] Dey, A. K., Mankoff, J., Abowd, G.D., and Carter, S. Distributed Mediation of Ambiguous Context in Aware Environments. In *Proc. of UIST'02*, Paris, France, 2002.

[7] Open Sound Control (OSC) http://www.cnmat.berkeley.edu/OpenSoundControl/