

Multimodal Knowledge for Designing New Sound Environments

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Abstract. To realize new sound environments to enhance music society, we have designed two systems. One is the club environment system that makes it possible to create a DJ's expressions with much more variety by handling the sound flow and makes it easier to comprehend the atmosphere of an audience by providing the images of environmental cameras. The other is the karate training system which enables a trainee to acquire the correct motions by providing feedback sounds triggered by the user's motions. We have tested the effectiveness of these systems through experiments.

1 Introduction

The present music industry emphasizes the establishment of a new style of performance or training[1–3]. However, they have weak consciousness about "Design of Sound Environments" which includes a performer and an audience, or the whole environment. In order to make the musical field superior, it is important to enhance the interaction between a performer and an audience. Therefore we should work on the development of new devices, software and the infrastructure to design new sound environments.

We focus on the technologies of sensing and understanding to create and interact with multimodal knowledge contents[4]. The multimodal knowledge contents consist of multimedia such as video and audio, and knowledge media such as text and know-how. We have been working for several learning domains, including high school education on computer science and physics, know-how of playing "Karate"[5, 6], assistance in cycling[7] and mountain climbing[8], and know-how of playing musical instruments. We are envisioning that the rich and useful multimodal knowledge contents can enhance and activate not only people and societies but also industries and business.

In this paper, we designed new Club and Karate Training environments with use of multimodal knowledge contents, and discuss the importance of gathering and utilizing know-how, multimodal knowledge contents and sensing devices.

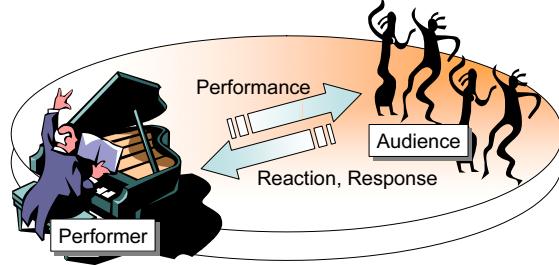


Fig. 1. Communication between a performer and an audience.

2 Design of New Sound Environments

In the new sound environments, we consider that "communication" between a performer and an audience is based on the performance by the performer and the feedback from the audience (Fig.1). It is important to enhance their communication with multimodal knowledge contents.

Performance: Communication from a performer to an audience We support the expansion of the expression by a performer, not only to assist the performer's play style but also to allow individual expressions making use of the environment by developing unnoticed technologies and infrastructures.

Reaction, Response: Communication from an audience to a performer A performer must be sensitive to the atmosphere of an audience and produce the environment which pleases them. Here, we provide information necessary for a performer as multimodal contents based on the information on an audience and the atmosphere collected with the sensors.

2.1 Design of a New Club Environment

In a club, a DJ performs with his personality to bring about the change of tempo or rhythm conveniently. Meanwhile it is said to be important for the DJ to perform sensing the whole atmosphere with attention to the mood of an audience and the space[9].

We will realize the expansion of a DJ's expressions by handling the sound flow and the environment to comprehend the atmosphere of an audience easily by providing images shot with environmental cameras.

2.2 Design of a New Karate Training Environment

In karate training of basic motions and KATA, using sound is effective to measure timing[10, 11]. During the instruction to beginners, there are several important

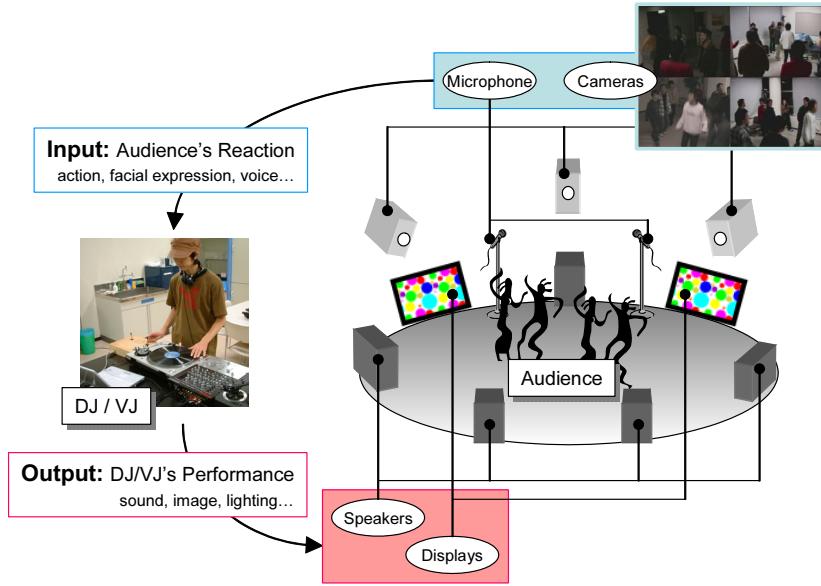


Fig. 2. A New Club Environment

points even in one basic motion. Moreover, it is very difficult for beginners to check the correctness of smaller motions like waist-twisting or arm-twisting on video by themselves after training.

We argue that sound feedback is very effective in so many different ways in karate lessons in order for trainees to pay attention to the various parts of their body and understand actual motions.

3 Implementation

3.1 A New Club Environment

Fig.2 shows the newly developed environment which enables us to enrich a DJ's expressions and give feedback to a performer based on the responses of an audience. Installed in the hall are 8 sets of speakers, 8 cameras built in them, three 50-inch screens, and some microphones.

Fig.3 shows the newly developed sound volume control application, controller, and types of expressions using the speaker array. By controlling the sound volume of the speaker array, a DJ can bring impressive effects as the motion of sound. Herewith we can realize the environment that can make an audience standing at the center of the hall hear sounds from arbitrary directions with arbitrary volumes.

It is easy to obtain an audience's motions, behaviors, facial expressions and voices by using cameras or microphones installed in this environment. And by

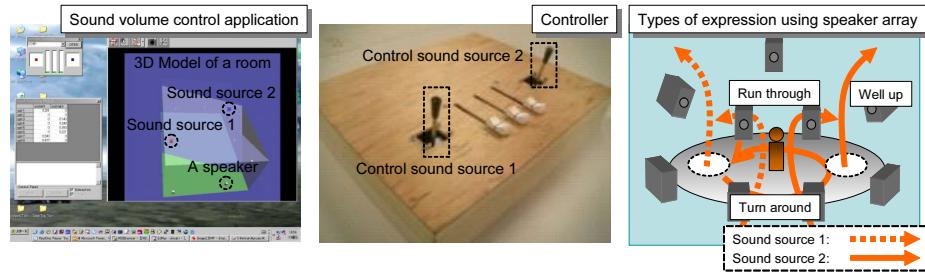


Fig. 3. Sound volume controller and Types of expression using speaker array

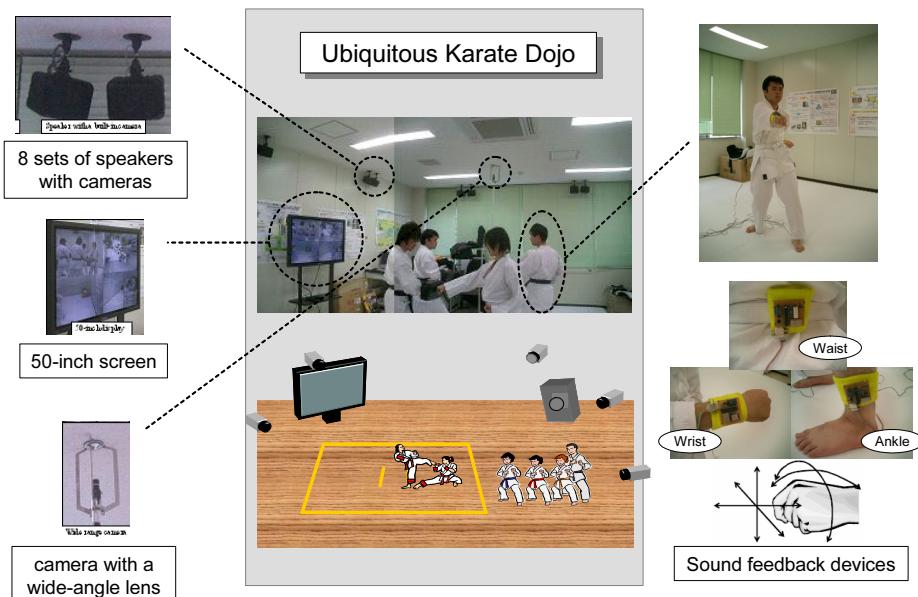


Fig. 4. Ubiquitous Karate Dojo

giving a DJ this information, it becomes easy for a DJ to comprehend the atmosphere and demand of an audience.

3.2 A New Karate Training Environment

Fig.4 shows a training scene of Karate we suggest. Installed in the hall are 8 sets of speakers, 8 cameras built in them, a camera with a wide-angle lens which can take pictures of the whole room, and a 50-inch screen which can display contents.

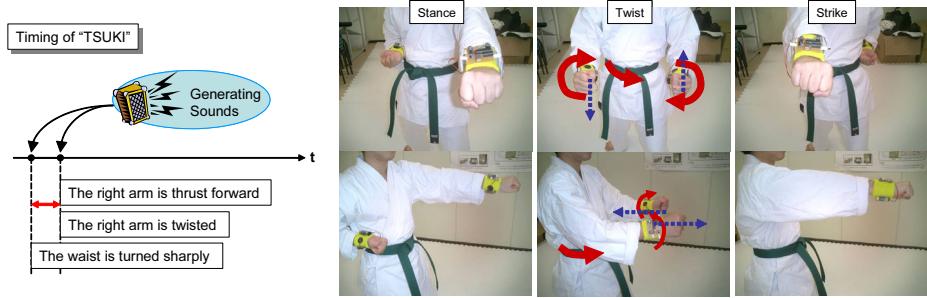


Fig. 5. Twist of the wrist for powerful TSUKI (device put on both wrists, both ankles, and the waist)

The sound feedback device we propose makes it possible to measure the acceleration of each part of the trainees' body. This device also makes it possible to measure karate motions and give trainees sound feedback in real time. This device is equipped with the 2 axis acceleration sensor (ADXL202) by Analog Devices, Inc, a sound generator LSI (ymz294) by YAMAHA CORPORATION and the micro processor (PIC16F876) by Microchip Technology Inc.

As shown in Fig.5, in practice of the basic motions like TSUKI or KERI, a beginner can assess the correctness and incorrectness of his actions by comparing his sound feedback with the trainer's sound feedback.

And a trainee can browse on the display contents such as the way of training. They can see their motions on video in real-time by shooting the training scene with environmental cameras.

4 Considerations

In the club environment, we made experiments in handling the sound flow. By changing the way of moving sounds to the genre of music, we succeeded in expanding a performer's expressions. Moreover, by giving a performer feedback from an audience on video, he or she can easily know the atmosphere and perform effectively.

In Karate training, it is hard for a trainee to get an aural instruction and understand smaller motions, which leads us to utilize sound feedback. In training of TSUKI, which is one of the basic motions of karate, it becomes easy to recognize the timing of motions by listening to the feedback sounds triggered by a trainer's motions of the waist and arms.

Experimental results show that providing multimodal knowledge contents, which are intended to expand a performer's expressions or giving more feedback about an audience's atmosphere, is effective in the expansion of the capability of music performance.

5 Conclusions

To conclude, we confirmed that we can enhance the music industry and create new musical environments by providing multimodal knowledge contents and facilitate communication between a performer and an audience.

For the future development of music society, we must consider not only skills of performance or the superficial design of the environment but also how to make a performance enjoyable and exciting or to create the sense of oneness in the situation considering all the members participating there. Even in fields like Karate that look quite unconnected with music, there are great possibilities of interacting with music. We'll pursue the new possibilities of music from a broader perspective.

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