Augmented Stages for Installation-Arts and Performance

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Abstract

This paper presents a multi-disciplinary project, which aims to create an intuitive and non-intrusive interactive audio-visual performance interface that offers the users or performers real-time control of multimedia events using their physical movements. From a straightforward definition of a trans-domain mapping (TDM) framework, this paper reports three implementations and collaborative-projects using the proposed framework, including a motion and colour sensitive system, a sensor based system for triggering musical events, and a distributed multimedia server for audio mapping of a real-time face tracker. Recent public installations and performances using these systems are also reported. In addition to considerations on interactive technologies using motion and colour tracking, plausible future exploration on stage augmentation with virtual and augmented reality are proposed and discussed.

Keywords: installation, multimedia, vision, sensor, tracking, motion

1 Introduction

Physical movement, gesture and expression play an important role of stage performances, irrespective of the mode of human communications; verbal or non-verbal, or the language used. With the advancements of electronic and computing technology, there has been increasing interests in new musical instrument design to augment traditional instruments (Schoner, Cooper and Gershenfeld 2000) with new capabilities, for examples, triggering digital sound and visual output (Paradiso *et al*. 2000), as well as new interface designs to provide better ergonomics considerations, and/or offer simpler instrumental control to a wider users. With such systems, the mode of interfaces, sensitivities and reactions (output) are highly flexible and can be configured or personalised, allowing better access to musical instrument playing with shorter learning time requirement.

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Basic requirement of such interaction, at the fundamental level, is an action-reaction model, which maps a specific movement to an audio event. Figure 1 summarises the basic framework of the trans-domain mapping of one creative domain onto another.

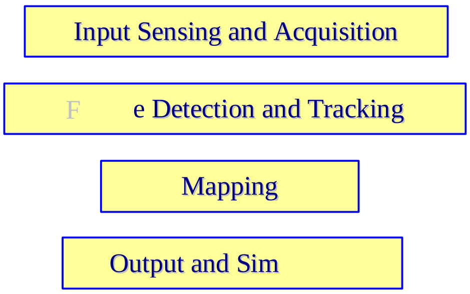

Figure 1: Main TDM modules.

The acquisition module consists of data capture system, which interfaces the framework to the real world environment. In this paper, a number of acquisition module implementations are presented, including, digital video and physical sensors. The feature detection and tracking module would contain algorithms to locate and follow certain predefined features in the input data, such as colour, shape and motion. The mapping module is made up of an extensible set of

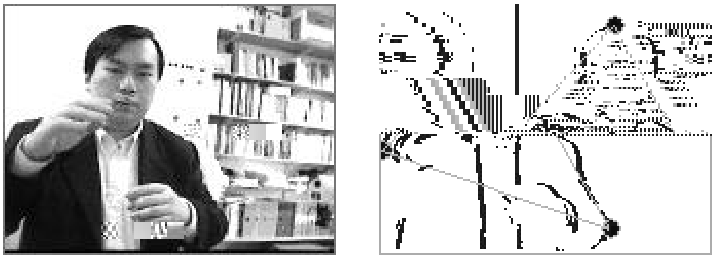

Figure 3: MvM frame-differencing module.

Basic mapping functions include a distance-to-MIDI-events mapping, with many configurable parameters, such as scale-type, pitch range and others. Musical mapping can be enhanced with a database of composed musical phrases and several mapping layers can be overlaid in order to produce multi-layered and polyphonic effects. MvM also offers user configurable *active regions* where detected visual activities in certain areas can be mapped onto different MIDI channels.

There has been an increasing interest in MvM collaborations from a variety of disciplines. In addition to original intensions for basic multimedia event triggering, choreographers, dancers, composers and artists have found many creative applications for the prototype. There may also be applications for music therapists, to encourage movement, using this motion-sensitive system to provide interactivity and creative feedback.

With MvM, the whole body of the user acts as a musical instrument interface, which determines the tempo, volume and audio generation of the performance.

2.2 Coat of Invisible Notes (CoIN)

With the MvM prototype described above, CoIN is a collaborative project designed to bring together multiple creative domains to build special costumes, music and dance within an interactive audio-visual performance interface simulated by the MvM.

Figure 4: Colour detection module tracks the colour of costumes to trigger special sound effects (left), and two groups of dances generating a two (MIDI) channels musical interlude.

For CoIN performances, MvM is configured to detect and track the colour where visual changes were detected. Detected colours are used to control the choice of musical sound and effects. This feature is fully explored and is particularly apparent in a section of the choreography where the dancers are divided into two groups, wearing costumes in different colours. The contrasting movements and interactions between the two groups create interesting musical dialogues with two different musical sounds (see Figure 4). The costumes designs feature reversible and modular parts, allowing the dancers to reconfigure and reassemble the costume to create different visual effects, and at the same time, these transformations are detected and reacted by MvM. Hence the visual changes of the costumes can also be used to control the character of the musical responses.

Figure 4 presents rehearsals with MvM colour tracking sub-module, to trigger special sound effects with colour, and Figure 5 presents snapshots from a public performance.

Figure 5: Snapshots of a CoIN/MvM public performance.

2.2.1 Interactive Performance with MvM

intended for mediating interaction between humans and machines (Devin and Hogg 2001). Figure 6 shows the triangulated facial expression, and Figure 7 illustrates the real-time face tracker system.

Experimentations on various different mapping approaches, using the face shape contour, represent the works in hand.

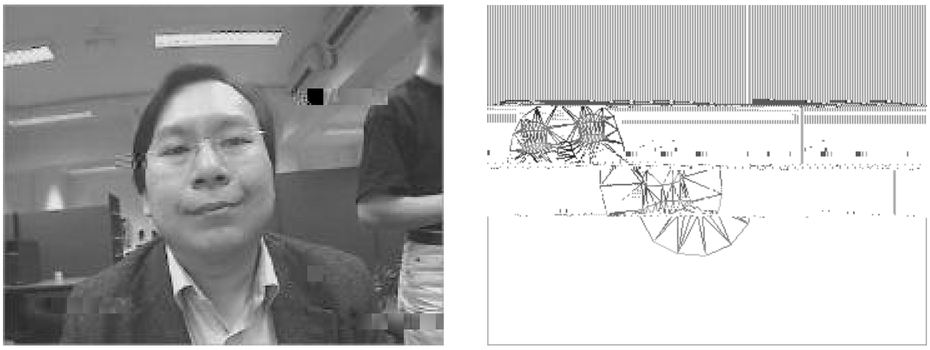

Figure 6: Live video input (left), and the triangulated tracked face shape (right).

Figure 7: Real-time Face Tracker system with spline curves classifying primary face structures.

4 Future Direction and Conclusion

Beside multiple cameras input, other sensors and imaging technologies, such as thermal, infra-red, and range imaging, could be integrated into the framework. Future plans also include behaviour modelling (Johnson, Galata and Hogg 1998), and other motion, gestural and expression trackers (Camurri *et al.* 2000).

In addition to the video and sensor tracking of human motion for creative mapping, the data could be used to automatically generate statistical models of typical trajectories and motions (Johnson 1998). With such models, realistic behaviours can be generated and applied to control virtual performer (Volino and Magnenat-Thalmann 1999, Badler *et al.* 1999) simulation, which could interact with human performer/user.

The stage can also be augmented visually (by means of video projection, large display or other technologies) with computer graphic, which could be influenced and animated by the mapping module, and more interestingly, by using 3D model of real-environment to transform the stage. However, current VR display technology is relatively limited, comparing to a theatre or cinema, in term of the number of audiences.

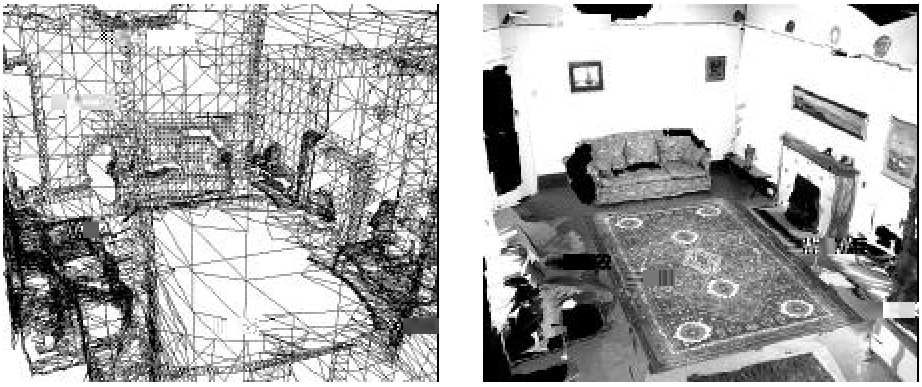

Figure 8: 3D wire-frame model generated from 3D data captured by a laser range finder (left), and for

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