SIMULATING SYNAESTHESIA IN REAL-TIME PERFORMANCE: USING SUBJECTIVE USER-INTERACTION MODELS IN 3D SPATIAL ENVIRONMENTS

In this paper the author will describe and show examples of his live audio-visual work for 3D spatial environments. These projects use motion tracking technology to enable users to interact with sound, light and video using their body movements in 3D space, simulating the effect of synaesthesia.

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Technical Introduction

Using the tracking capabilities of the *Gesture and Media System* - invented by APR of Edmonton, Canada - two or more users can use space as an audio and video remix or performance tool. The *Gesture and Media System* allows artists to "map" an interactive space with sound, light and images, and to have user-movement dynamically control these elements via small 3D trackers.

In the author's spatial projects audience members can interact with sound, light and video in real-time by simply moving around in space with a tracker in hand. Changes in sound, light and real-time visual effects can be synchronized with changes in sound and or light (i.e. music volume = light brightness = video opacity). These changes can be dynamically mapped in real-time to allow the user to consolidate the roles of DJ, VJ and light designer in one interface. This interaction model simulates the effect of synaesthesia, in which certain people experience light or colour in response to musical tones.

Synaesthesia

Synaesthesia is a condition is which a person experiences sensations from one sense in a second different sense. The likely most common occurrence is a description of colour related to musical tones. "How does it feel to hear music in

color, or to see someone's name in color? These are examples of synesthesia, a neurological phenomenon that occurs when a stimulus in one sense modality immediately evokes a sensation in another sense modality. Literally, "synesthesia" means to perceive (*esthesia*) together (*syn*). [1]"

VIRTUAL DJ Concept

The original concept of *Virtual DJ* was to create a virtual room in which the audience could interact with sound and light by simply moving around with a tracker in hand. With an acknowledgement to the obvious connections with the earlier work of David Rokeby [2], *Virtual DJ* is designed as a comparatively populist project, one in which the audience can interact in a very physical, almost aerobic manner to dance-oriented electronic music.

Virtual DJ uses two motion-trackers, one controlling drum and bass, and the second controlling melodies and samples. Certain motions have been standardised to create specific sound effects: raising the hand in the melody tracker usually results in a rising melody, raising the drum and bass tracker results in a change of drum patterns. Similarly lights are used to give the users a physical sense of the sound zones in the room: when users move within sound zones lights dynamically change in synch with their movements. This interaction model simulates the effect of synaesthesia, in which certain people experience light or colour in response to musical tones.

In *Virtual DJ* the 3D space has been mapped meticulously to allow users to have a satisfying interactive experience regardless of the style of their interaction. The spatial mapping was reworked based on the results from beta tests of hundreds of users over a two-three year period. These tests were both formal (i.e measured beta tests in a controlled studio environment in which I wrote down user reactions and responses) and informal (i.e. resulting from a performance after which I arranged a follow up studio session with users).

Virtual DJ uses robotic lights to simulate the behaviour of humans and to represent human agency. The environment of *Virtual DJ* exists as a living, sounding space that behaves in a predictable manner in relation to the user. To the casual observer it seems as if the space is alive; to the performer the precise matching of sound and light gives the air an almost tactile quality.

VIRTUAL VJ Concept

Virtual VJ takes the concept of *Virtual DJ* one step further and unites the role of the DJ and VJ into one interface: 3D space. The concept of *Virtual VJ* is to allow two users to control different aspects of the sound and video environment with their movements. One tracker is set to trigger sound and video and the other is set to manipulate the sound and video initiated by the first tracker.

The key conceptual idea that is explored is the idea of cooperation and the sense of personal space in ephemeral, virtual systems. This is achieved by programming the trackers so that dramatic events will happen when the two trackers are close together or at a distance. For example the environment has been programmed so that the trackers apply dramatic effects such as distortion to the audio when they are proximate to each other or reverb when they are distant from each other. This results in a game of cat and mouse in which the users determine whether they will chose to closely follow the movements of the other participant or pursue a more individual experience.

Enabling Subjective User Interaction In 3D Spatial Environments

Both *Virtual DJ* and *Virtual VJ* are based on the basic interface design strategy of using redundancy to enhance immediate user interaction. In common usage redundancy is often thought of a negative term, but in computer-controlled environments the use of redundant information in an interface design can often lead to greater user clarity, particularly when the information between mediums is sufficiently obvious.

In *Virtual DJ* lights and sound are matched very precisely. When a user perceives a change in sound due to a movement, the lights will change in a similar manner. This redundant information over the two mediums allows users to experience a more tactile sense of space and to more easily infer how their interactions are affecting the audio-visual environment. In *Virtual VJ* the redundant information is passed between the audio and video realms in a similar manner to *Virtual DJ*.

Similarly both environments have been mapped in a way that allows them to at all times produce a predictable result (i.e in *Virtual VJ* raising the hands will usually produce a rise in volume and an increase in image opacity). At the same time users are free to roam wherever they wish, to combine audio and visuals in whatever manner they chose.

This predictability is in fact an asset in that it allows users to lose their self-consciousness when interacting: they do not fear playing "wrong notes". This is in opposition to many similar environments in which users are often mystified by the interaction model due to a lack of spatial planning or an over-complex interaction model. On the other hand the spatial

mapping in *Virtual DJ* is quite complex; in many areas of the room several parameters are changed simultaneously by different motions; however, because the changes are logically mapped to movements and the results are predictable and repeatable, users gain a sense of control that they would not otherwise have in more "randomly" mapped spatial environments.

Conclusion

Using a combination of motion-tracking with matched live video, sound and light, the artist can create the illusion of synaesthesia for participants and viewers. Uses can intuit spatial interaction interfaces more effectively with redundant information programmed between the different mediums. This assists both users and viewers with interactivity in the unfamiliar medium of 3D spatial environments and helps establish formal and aesthetic meaning, and avoiding the pitfalls of random and over-complex interface design and programming.

Acknowledgments

Technology and Production Support for *Virtual DJ* was provided by CANARIE, The Canadian Foundation for Innovation, APR Inc, and The Interactive Institute Stockholm. Production Support for *Virtual VJ* is provided by Culture Lab, University of Newcastle. For further information on *Virtual DJ* and *Virtual VJ*, including documentation, please see http://www.telebody.ws/VirtualDJ

References and Notes:

1. 1. C. van Campen. The Hidden Sense: Synesthesia in Art and Science (Cambridge, MA: MIT Press, 2007), 1.
2. 2. D. Rokeby, (1986-1990) Very Nervous System. http://homepage.mac.com/davidrokeby/vns.html (retrieved April 20th, 2011).