Subjective User-Interaction Models in 3D Spatial Environments: Virtual DJ and Virtual VJ

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ABSTRACT
In this demonstration the author will describe and show examples of his 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. Specific video examples of one past project (*Virtual DJ)* and one current project (*Virtual VJ)* will be shown to illustrate how subjective and flexible user interaction is enabled through a complex but predictable mapping of 3D space to media control. This demonstration will be supported by an evening performance (please see the attached document *Virtual VJ CHI.docx).*

Author Keywords
Motion tracking, user interaction, 3D space, live audio, live video, synaesthesia, networked environments, virtual reality, DJing, VJing.

ACM Classification Keywords
H.5.1 Multimedia Information Systems: Artificial, augmented, and virtual realities. H.5.2 User Interfaces: Input devices and strategies.

General Terms
Design, Experimentation, Performance.

INTRODUCTION
This demonstration will show how simple motion-tracking interfaces can be used in complex ways to enable subjective user experiences. 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.

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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 [1], *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 standarized 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 NETWORKED VERSION
A version of *Virtual DJ* has been developed to allow two geographically-removed performers to interact with the piece simultaneously. With the help of the programmers from APR, a version of the tracking software has been developed to allow positional information to be delivered over a high-speed research network (CA4net in Canada), thus allowing the users at each site to hear and see the results of the remote person's motions.

VIRTUAL DJ: ROBOTICS AND TELEPRESENCE

Virtual DJ uses robotic lights to simulate the behavior of humans and to represent human agency. In the network performance of the piece a light stands in for the remote participant and moves around apparently autonomously, but with obvious intent. Similarly the audio world is activated by this remote participant, but the lack of a physical presence makes the interaction seem spectral. The environment of *Virtual DJ* exists as a living, sounding space that behaves in a relatively 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.

Figure 1. Steve Gibson, *Virtual DJ,* Live at Stealth Attack Nottingham, Incubation 2005 Conference. Photo by Jonathan Griffiths.

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 or more users to control different aspects of the sound and video environment with their movements. One tracker will be set to one group of audio tracks (i.e. drum and bass) and the other will be set to different sound sources (melodies and voices). Similarly one tracker will control one set of images (including video, animated graphics, drawings and visual effects) on one screen and the second tracker will control a second set of images on a second screen.

The key conceptual idea that will be explored is the idea of cooperation and the sense of personal space in ephemeral, virtual systems. This will be achieved by programming the trackers so that dramatic events will happen when the two trackers are close together. For example the environment could be programmed so that the trackers apply dramatic effects such as distortion or saturation to the audio channel(s) of the other tracker when they are proximate to each other. At the same time the video images from the two trackers could bleed into each other and add video effects when the same proximity of the two trackers is observed. This may result in a game of cat and mouse where the users determine whether they will chose to closely follow the movements of the other participant or decide whether they wish to pursue a more individual experience. In essence the user experience will be in a constant state of flux depending on the inclination of the users.

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. Redundancy is often thought of a negative term in common usage, 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 will be 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 locally (i.e in *Virtual VJ* raising the hands will usually produce a rise in volume and an increase in image opacity) but at the same time users are free to roam wherever they wish, to combine and re-combine audio and visuals in whatever manner they chose. In the case of *Virtual DJ* the space has been tested extremely thoroughly so that users will almost always have a satisfying experience of the space.

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 or randomized 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 (x, y, z changes or velocity for example); 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.

This predictability combined with the redundancy over the audio-visual mediums allows for a distinctly subjective experience in which users can assert their personal agency over a pre-composed environment. While the structure of the environment is in a constant state of flux depending on

user movement, the environment is always predictable on spatial and gestural levels.

CONCLUSION

This demonstration will illustrate both the technical and conceptual concerns of planning complex spatially-based environments. Using video documentation the workshop participants will be made aware of the structural and aesthetic importance of intensive pre-planning and testing to achieve a subjective and personal experience for the user. This demonstration will be supported by a performance of *Virtual VJ* with Stefan Müller Arisona on Night One of the workshop.

For further information on *Virtual DJ*, including documentation, please see http://www.telebody.ws/VirtualDJ

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