NEW MEDIA RESEARCH
at
The Banff Centre for the Arts

PHILOSOPHY

New Media Research at The Banff Centre espouses an artist-centred paradigm of research and development. The project envisions a media-connected society in which cultural material, information, entertainment, and social interaction is delivered interactively to the individual, at home, in the workplace, and on the move. We believe that artists have a vital role to play in developing a new digital culture; that application and usage are critical driving forces in the research and development process; that this is particularly true of technologies that involve computer-human interaction; and that the experimental artistic applications and usage carried on uniquely at the Banff Centre are an especially rich source of information, design, functional specification, testing and innovation in applied research.

Since 1988, the Banff Centre's Media Arts program has carried on experimental, culturally-grounded production in the mediums of TV/video, sound/audio, computer graphics, integrated media, and virtual environments (VR). The program provides its artist community with a high-production environment that includes advanced computer-based tools for composition and manipulation of image and sound. The combination of creative resource, technical facility, and focus on interactive process, each pursued to the highest possible standard, has led to a critical mass of expertise and innovation at Banff. The work of artists in this environment inspires surprising solutions to technical problems posed by digital culture, and an awareness of technical challenges and opportunities that are not apparent in traditional research laboratories.

It is widely recognised that a computing revolution is taking place, as the functions of computer, home entertainment system, television, and telephone/cable service merge and mutate. This will create the possibility and desire amongst consumers and users of technology to have personal control of their media environments. To succeed in this context, research concerns and industry will need practical understanding of how people want to involve machines and computing power in their lives. Such knowledge will not develop in the abstract, it must be learned by prototyping, experimentation, observation and usage testing. We believe that The Banff Centre's media artist community has a special role to play in advancing this kind of knowledge and understanding. The New Media Research project seeks to foster an intimate marriage of technical research and artist practice that will create benefits for culture, industry and society.

The principal software development activity of New Media Research is the ToolWorX Media Production Environment.

TOOLWORX MEDIA PRODUCTION ENVIRONMENT

ToolWorX is the in-house name for a collection of production and authoring tools designed to serve the needs of professional artists and content creators working with the new forms and mediums made possible by the latest digital information technology. Specifically, these tools deal with production tasks in immersive/interactive mediums such as virtual reality, interactive TV/video, telepresence, and multi-user media environments.

The project focuses on the development of portable, extensible user interfaces that can access signal processing resources on a variety of platforms (audio, video, graphics servers) in a heterogeneous networked environment. Some specialised processing algorithms are also developed in order to implement and test the user interface design.

ToolWorX software modules will plug into existing operating environments for realtime media processing, and add "niche" functionality and value to such environments. They are not free-standing or self-sufficient applications. Therefore, they focus on application-specific interface design technology and special-purpose processing algorithms, rather than whole systems.

While the principal market that drives the development of these tools is the high-end professional user, a strong secondary motivation in this research is to create technology that can be scaled to a range of user levels, as well as to multiple computing platforms. The professional production tools of today and next year will be tools for the home and office desktop creator five years from now.

Research partners in this project will provide additional user interface design, server and signal processing resources, and distributed network technology, while New Media Research takes the lead in defining functional specifications and testing the usability of the environment. Production partners will provide additional resources for testing the developed software in artist-driven production situations.

TOOLWORX MODULES

Virtual Sonic Space™

Virtual Sonic Space (VSS) is a realtime processing algorithm which convolves head-related transfer functions (HRTF's) with an input signal to create the illusion of audio sources localised in a 360° sphere around the listener's head. VSS is primarily intended for virtual reality applications, where rich simulation of an immersive environment requires that sounds appear to exist in a three-dimensional space and move realistically in response to the user's movements and to the dynamics of the simulated environment. This technique is generally more convincing than practical multi-speaker diffusion systems, but it works only with headphones. In addition to virtual reality applications, VSS can also be applied in mediums such as teleconferencing, telepresence, music/sound production, and entertainment software.

MixNet™

MixNet is a user-configurable interface design for control of realtime audio processing and composition resources. It was developed initially through collaborative research with State University of New York at Buffalo (SUNY). The current demonstration version works on top of the FTS realtime audio DSP processing environment developed by IRCAM (Paris). Recent work at Banff has focused on portability to other platforms (using Silicon Graphics computers as a proving ground), and carrying the audio-specific concepts of MixNet into the broader context of integrated new media, including video and realtime computer graphics.

The key concepts addressed by MixNet are *dynamic configurability* and *dynamic allocation of resources.*.

Dynamic Configurability in MixNet allows users to design their own "custom" audio devices by assembling the component parts of the desired device (volume controls, inputs and outputs, equalisers, delays etc.) from a "palette" on screen. Depending on the processing power of the host computer, such a user-designed audio device may be extremely complex or quite simple. More importantly, it allows a single general-purpose computer (or network of computers) to accomplish an infinite variety of sound-handling tasks, including a wide range of tasks that are not possible or even imaginable using discrete hardware components.

Dynamic Allocation of Resources allows MixNet to operate in flexible ways that respond to the needs of future content and production tasks, especially interactive content (learning, multimedia, communications, entertainment) and real-time production (virtual reality, telepresence, remote work). The idea here is that a processing system working in these contexts must be able to respond to unpredictable demands, according to the "real-time" needs of the moment (user choices and input). It is inefficient and expensive to address this requirement in the traditional way, by throwing massive resources at the problem, and leaving most of these resources idle most of the time. Dynamic allocation allows MixNet (or similar real-time computing environments) to adjust itself on the fly to changing user needs, and make maximum use of minimum resources. A related technology implied by MixNet is dynamic allocation across networks, so that additional resources can be added by "plugging in" additional processing power as needed.

Implemented Features: N-channel configurable virtual console, with DSP object palette. There may be as many input strips as desired by the user. A horizontal scroll bar allows the user to access more channels than can fit across the screen. Signal paths are constructed virtually, on the fly. There is no explicit MAX patch running behind the console.

1. Each input strip contains, minimally:
   stereo panner with automatic return to centre function and virtual centre detent
   on/off switch
   sawtooth wave source
   mode select button (mix/edit)
   strip global automation record enable, read enable and safety switch
   text input field
   vertical scroll bar

2. The palette panel contains the following DSP objects:
   fader
   mute
   solo (for now, always passes signal)
   EQ (for now, always passes signal) with in/out switch
   aux send (for now, always passes signal) with send level fader, send channel select, and auto
      unity gain

DSP objects may be dragged from the palette and dropped at will into channel strips in the console panel. Each DSP object contains a "pop the hood" button (for control customisation) and an automation record on/off switch.

FrameWorX

FrameWorX is a user-configurable interface design for control of realtime media composition and processing. It extends design concepts developed for audio in the MixNet project, to other electronic mediums, data types and production formats. It is in the initial stage of functional specification, and a prototype system will be implemented in late 1994 for initial user testing.

The key objective of FrameWorX is to develop a production environment that facilitates the creation of multiple formats of end product, both linear and non-linear, from databases of source materials. The prototype will test applications in multimedia production and interactive content delivery. Research partners in this project will provide component technologies that support the prototype environment, including high-bandwidth networking, static and dynamic modelling, linear and non-linear image composition, and multimedia database. Production partners will create opportunities or contexts for

testing content development and delivery, and they will take an active role in defining the features of the prototype environment, with special attention to diverse cultures as rich sources of design input.

SketchWorX

This is a behaviour-modeling tool for the development of interactive media work, including virtual environments and immersive simulations. It is in the initial stage of development, conceptual design and specification. It builds on work begun at the University of Alberta's virtual reality lab, a computer animation design tool called JD-CAD, which was developed as an extension to U of A's MR Toolkit software. The tool allows the user to create a simple representation of an object from a selection of 3D geometric primitives (e.g. cones, cylinders, blocks), group primitives as more complex objects, animate objects through "key-frame" animation, and define time-variant behaviors between objects (e.g. rotate, orbit, follow, block).

After modelling a scene and/or behaviors on the flat screen, the user may immediately explore the created environment in 3D simulation (VR headmount display). The user sketch generates code that may be refined and detailed by a programmer.

THE BANFF CENTRE'S PRODUCTION & RESEARCH FACILITY

The Jeanne and Peter Lougheed building at The Banff Centre was built in 1988. It houses production facilities for audio, video, and multimedia work, as well as the New Media Research Lab that opened in February 1994. All of the production and research areas are thoroughly wired for video, audio, intercom, timecode, MIDI, EtherNet and Appletalk connectivity. This allows for a great deal of flexibility in the deployment of the building's technical resources. The building also has studios for artists working in the production areas, audio-visual and photography resources, and administrative offices.

NEW MEDIA RESEARCH CENTRE

Officially opened in February 1994, this research lab includes workspaces dedicated to software development and production testing in the three key areas of virtual reality, digital audio, and video/multimedia. They are joined by a shared workspace for development and workshopping of presentation/installation systems. The lab also contains several small individual studios for artists and researchers involved in current production activity.

Audio pavilion

This workspace houses the network of three NeXT-based IRCAM Signal Processing Workstations, and a Silicon Graphics *Indy* computer. MIDI, audio, and control links to all other production areas make it possible to integrate the ToolWorX development environment with existing high-quality audio production gear, and with other elements of large-scale multimedia and virtual environment presentation.

Video pavilion

The key production resource in this area is the Avid *MediaComposer* non-linear editing and production system. It is fully linked to other rooms in the New Media Research Lab and the Media Arts production areas to facilitate connectivity with realtime image processing and graphics, BetacamSP online production, Mac and PC-based authoring systems, external digital video effects, and direct video capture from live sources.

Computer pavilion

In the course of their work at the Centre, artists and researchers have access to a wide range of equipment. The main engine for realtime immersive/interactive work with graphics is an *Onyx Reality Rack* from Silicon Graphics Inc. This machine is one of the fastest commercially-available computers for creating and displaying virtual environments in real time. The *Onyx* is running *MRToolkit*, virtual reality software from the University of Alberta. This software is particularly good at creating the kind of complex behaviours that are the hallmark of sophisticated virtual environments.

Other equipment includes two *VGX 310* computers from Silicon Graphics running design and modelling software by Soft Image and Alias Research, and a virtual reality system running Sense8 *WorldToolKit* software for the IBM PC.

AUDIO PRODUCTION

The audio production facility consists of four control rooms of varying capability, and two recording and presentation spaces. Each studio includes a Digidesign *SoundTools* hard disk editing system, DAT-format recorders, high-performance audio monitoring systems by S.O.T.A. and Westlake Audio, and a variety of signal-processing and sound-synthesis devices. They share a large pool of professional microphones (Neumann, AKG, Sony, Beyer, B&K etc.).

The main control room (*Luscar Control*) is a 24-track all-digital recording studio with Sony computer-automated console and multitrack recorder, Sound Graphix machine synchronisation system, Sony DAT mastering/editing system, and computer-controllable processing devices by Lexicon, T.C.Electronic, Eventide and Neve.

The audio-for-video control room (*Rice Audio*) is specialised for non-linear sound assembly synchronised with picture. It is based around an 8-channel Digidesign *ProTools* hard-disk record/edit system, Sony computer-automated console, Studer 8-track tape recorder with Dolby SR noise reduction, and processing devices by Lexicon, Symmetrix, Drawmer and Valley People.

The two smaller audio production rooms (*EARS* and *Nose*) are Macintosh/MIDI-based computer music studios. They are suitable for preproduction work leading to final realisation in the main studios, and they are compatible with the main facility through digital mastering formats (DAT, *SoundTools*). One room contains a large MIDI implementation with multiple synthesisers, controllers, processors, and samplers, as well as 16-track analogue tape recorder and a Soundcraft 24-input mixer. The other contains a smaller MIDI implementation, with a handful of sound generators and a smaller mixer.

The larger recording studio (*Project Studio*) is 1500 square feet, linked to all audio and video production areas by tie lines. It is also a multi-purpose, multi-disciplinary performance and production space, with 4/8 channel sound projection, lighting grid and Colortran control systems, sprung dance floor, video and film projection capability. Variable acoustics through movable sound-absorbing curtains diffuser panels, and baffles.

The smaller recording studio (*Luscar Studio*) is 450 square feet, linked to all audio and video production areas by tie lines. Variable acoustics through movable sound-absorbing curtains diffuser panels, and baffles.

Work supported in these areas includes CD master recording, soundtrack development for film, video, and multimedia, and electro acoustic composition.

VIDEO PRODUCTION

The television and video studios include a three-camera BetaSP format studio of 232 square metres. This sound isolated production space features 3/4 perimeter, 6.7 metres high, hard-wall cyclorama. Curtains include 360 degree black, 24 metres neutral grey and 24 metres chroma key blue. The lighting grid is 6.7 metres high with step-down to 5.5 metres, on a 4 foot centred grid pattern. It supports 180 dimmer- per-circuit electrical distribution: 168-2.4 kilowatt circuits; 12-6 kilowatt circuits, and is controlled by a Colortran *Prestige 2000 C* control board with *Dimension 192* dimmer rack. There is a full complement of fresnel, softlight, cyclorama, and pattern lighting instruments, ranging from 100 Watts to 5,000 Watts.

The Control Room is normalised for 3-camera multi-camera shooting and it is built around Ross 514 production switching and Sony BVP350 camera set-up area. There are two on-line edit suites with Sony BVE-9100 edit controllers, Sony BVW-75 BetaCam SP recorders en suite, with capability of additional machines including D2 format as required. The switchers are Ross 416's Chroma and Linear keyers, Matrix and Rotary wipes and extended switcher memory. Effects include Pinnacle Prizm Digital Video Effects (3-D signal channel) with DVEator™ option and editor interface, Pinnacle 2120 Digital Video Effects (2-D signal channel) with still-store, Chyron RGU-2 character generator, 2 channel output, and two Sony colour correctors.

COMPUTER STUDIO

This studio is available for use by artists creating virtual environments, as well as artists in all programs working with digital imaging. The emphasis in this room is on scanning, video frame grabbing, computer graphics, animation, 3D design, desktop publishing, and wordprocessing. The studio is equipped with 6 networked Macintosh computers, all with colour screens and hard drives of large capacity. We have a 300 DPI colour scanner that can accommodate originals up to 11 X 17 inches, CD-ROM readers, B&W and colour laser printers, and a film recorder for 35mm and 4X5 output. Most of the computers have a 40 megabyte removable media drive as well. Artists can capture images to computer from any format of video for manipulation prior to printing on paper or inclusion in documents or animations that can be recorded on video tape for subsequent presentation.