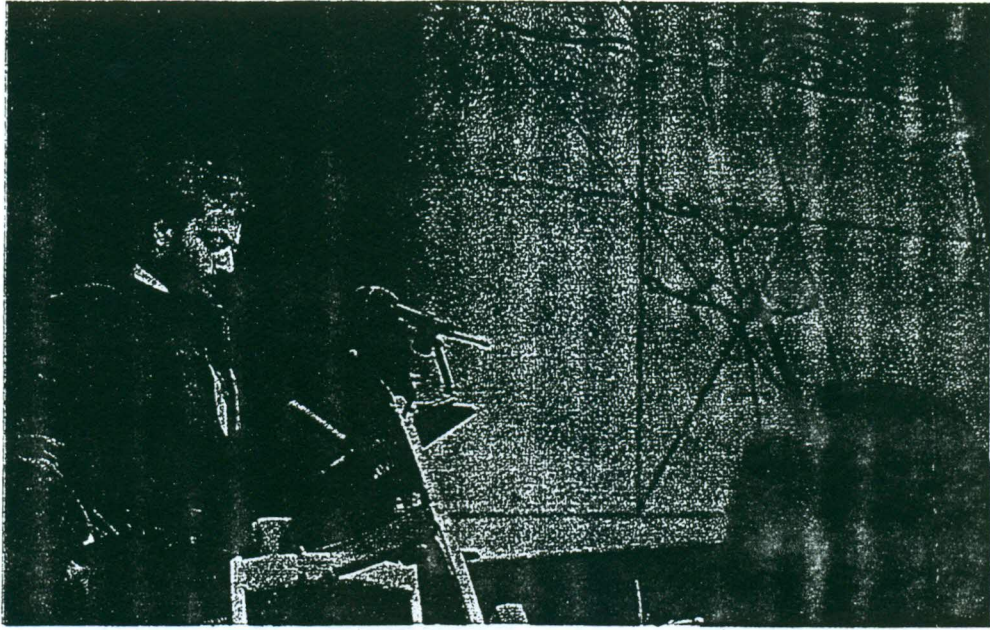


Doors of Perception Conference, Amsterdam, 1996



Ranjit Makkuni  
MULTIMEDIA  
& DESIGN

*Projects 1985 - 2000*

*Active Learning* is, in essence, participatory learning, which integrates the learner, learning content, and the access tools. In the purest form of active learning, the learner inevitably loses awareness of the tool and ultimately becomes absorbed in the learning content, the objective of one's learning.

Multimedia systems have made a presence in the classroom, the workplace and the home. However, contemporary tools separate the learner from the learning content. They provide surface level access to the content. Therefore, in order to unite the learner and the content through appropriate access tools, we, as multimedia researchers and as designers of multimedia documents, will need to re-"vision" multimedia tools for active learning.

Therefore, we use the term active learning to mean learning systems that provide the learner with "deeper" access to the learning content, as well as appropriate interaction modes that bridge *tool* and *content*.

## LEARNING AND COMMUNICATION

Multimedia documents are becoming commonplace in the work-place, the classroom and the home. While modern multimedia tools have provided learners with increased access to vast quantities of information and improved display media, they have not improved the qualitative dimensions of learning.

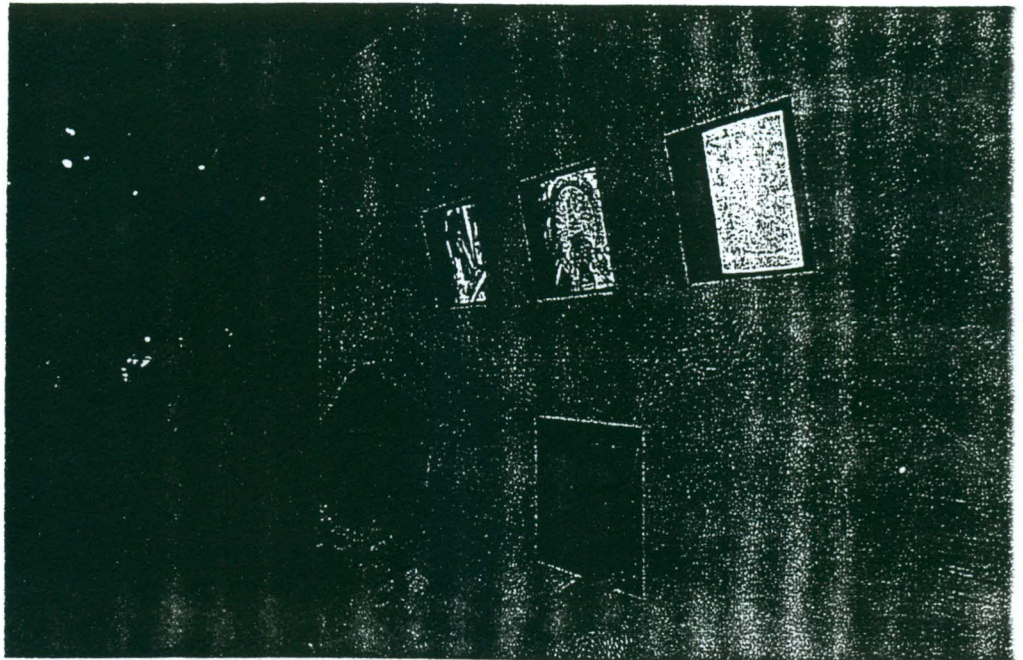
One of the central goals of active learning research is to explore tools and processes that will improve the *qualitative dimensions of learning* — tools which, as defined earlier, provide the learner with "deeper" access to the learning content, as well as tools which provide appropriate interaction modes that bridge *tool* and *content*. The qualitative dimensions are intimately related to the communities of practice in which the learning is situated. Tools must reflect the subtle values of a community.

## TRADITIONAL CULTURAL LEARNING MODELS

Today, the learning spectrum consists of experiences ranging from modern multimedia information presentation systems to the live experience of learning under the tutelage of a traditional master in the master-student apprenticeship.

An average multimedia information system is concerned mainly with the transmission of facts. Underlying the presentation of facts is a model of learning which considers learning as a process of information transfer between teacher and student. Here the learner is dormant, passively receiving the content through symbols, diagrams, classrooms, or syllabi. The transfer model is by definition limited, as it addresses symbol-making and manipulation activities, and leaves out experience in the world.

Figure 1.  
The Electronic Sketch Book  
of Tibetan Thangka Painting



A Russian student and an American student explore the Electronic Sketch Book of Tibetan Thangka painting installation at the Asian Art Museum of San Francisco. By pointing at and touching elements of the painting called Thangka to play back short video recordings, they use the

imagery of the painting to explore its process of creation, its use in Tibetan life, and its symbolic meaning.

Cultural artifacts, like the Thangka painting outside its cultural milieu in a museum, are by themselves unintelligible to the museum-learner.

The Electronic Sketch Book resituates the Thangka in Tibetan cultural practice and illustrates interrelationships between artifacts and composition-process, myth, ritual, physical setting. The multimedia exhibit shifts the focus of the learner from the outward form of Thangka

artifact to the inner world of Thangka process. The sketch book project, the result of a creative collaboration between a master Thangka painter, a renowned Tibetan monk, Xerox designers, and art historians and Tibetologists of the Asian Art Museum, was opened in 1989.

In contrast, any form of cultural learning in the traditional context under the tutelage of a master, consists primarily of *learning by doing* in a cultural context through intense interactions at all the levels and dimensions of life. The master provides the supports for the student to enter into the living, multidimensional world of a culture's images, myths, rituals, symbols, and interrelations.

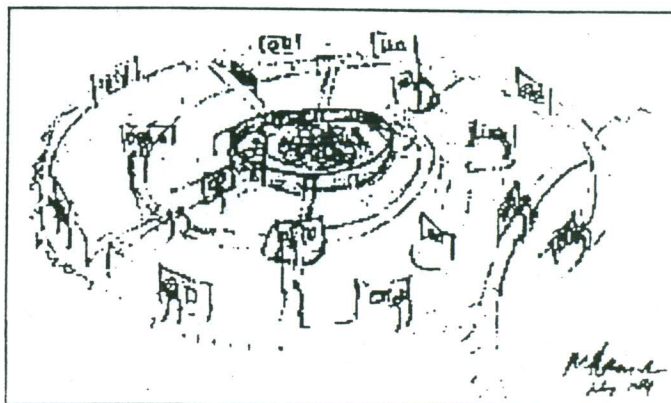
This view of learning *in situ* a cultural practice is complementary to the predominant view of learning as explicit transfer. However, the transfer model has determined the form of contemporary information presentation systems: That is, the computer as a medium capable of manipulating textual symbols; its input modalities consisting primarily of typewriter keyboard and mouse; its interfaces consisting of windows button pushing; and

its learning model consisting of "learning by accessing facts."

Therefore, if learning systems are to move beyond accessing facts to accessing cultural process and exploration, then we will need to re-vision the nature and role of multimedia in learning. Hence, the challenge for active learning is to explore bridges between the two models, i.e., multimedia learning systems and the learning *in situ* a cultural practice as embodied in the master-student apprenticeship. Towards this direction, Figures 1 and 2 illustrate two instances of cultural learning applications, The Electronic Sketch Book of Tibetan Thangka Painting (Makkuni, 1989a), and the Project Gita-Govinda (Makkuni, 1993).

Figure 2.  
Project Gita-Govinda

# DISTRIBUTED MULTILEVEL EXHIBIT



Indira Gandhi National Center for the Arts, New Delhi and Xerox PARC are producing a multimedia presentation exhibit on the Gita-Govinda. The Gita-Govinda is a 12th century poem expressed in the traditional "multi"-media of painting, music and dance (Vatsyayan, 1987).

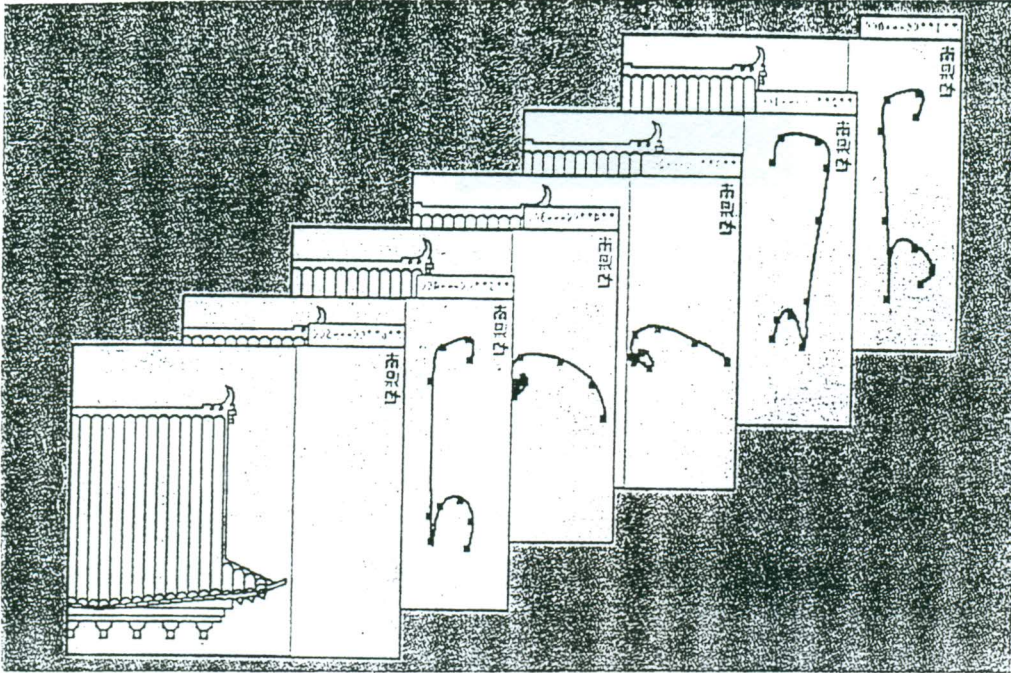
The form of the exhibit mirrors the interrelations among multiple dimensions and media of the Gita-Govinda. In order to understand the "whole" of the poem, its meanings and interpretation, the exhibit-goer will need to interact with a network of multimedia kiosks, each kiosk

focusing on a particular category of the Gita-Govinda content space. The exhibit-goer interacts with the network of kiosks, progressively discovering the Gita-Govinda, its multiple dimensions and multiple media of expression.

While the Thangka and Gita-Govinda projects illustrate pioneering applications of cultural learning models, the learner's interactions with these systems are based on the paradigms of windows and button pushing. Also, the learner can only access pre-recorded cultural imagery, and browse through networks of information paths. Accessing the network of links and paths in hypermedia systems can contribute to the user's construction of an understanding of cultural space. However, this represents

a passive use of computing media where the full potential of computing technology is still under-exploited.

While computing media has been used for understanding descriptions of cultural space, the challenge for us is to explore the use of computing as a medium of creation, i.e., to move beyond the play-back of pre-recorded imagery. Accordingly, the next sections explore other trajectories for active learning.



Gestural Interfaces are envisioned as a powerful means for interaction and provide kinaesthetic engagement with the cultural learning content. Figure above shows an illustration from Chinese Temple Editor Project (Makkuni, 1987). This project, implemented in 1985,

illustrates a completely "gesture-based" – keyboard-less – environment that allows learners to interact with the pictorial domain of temples, and to record their learning activities. The illustration at the top shows various stages of a designer's interaction process in the composition of

Chinese Temples. Each window illustrates a particular state-of-the-designer's interaction. On the left-hand pane of each window a calligraphic gestural mark is shown. This mark specifies both the design properties of the temple, as well as a trace which can be replayed by other designers.

Figure 3. Pictorial Browsing through Gestures

## MULTIMEDIA INTERFACES

Contemporary multimedia systems typically employ standardized means of presentation and interaction, such as "cards style" of presentation of the content and "point and click" and the button pushes to interact with the content. These standardized means of presentation and interaction are homogenizing the presentation of the learning content.

Second, despite the variety of media types, such as pictures, audio, and video, interaction with the learning content is still

based on text-based approaches. In typical presentations, the text medium is still the main form of narrative with pictures, audio, and video supporting the main text narrative. It could well be the other way round where pictures, audio and video carry the main narrative.

Third, contemporary systems treat the presentation of the content in terms of an assemblage of different media, not in terms of synthesis between different media. In summary, contemporary systems offer a

Figure 4.  
Pictorial Browsing through  
Diagrams

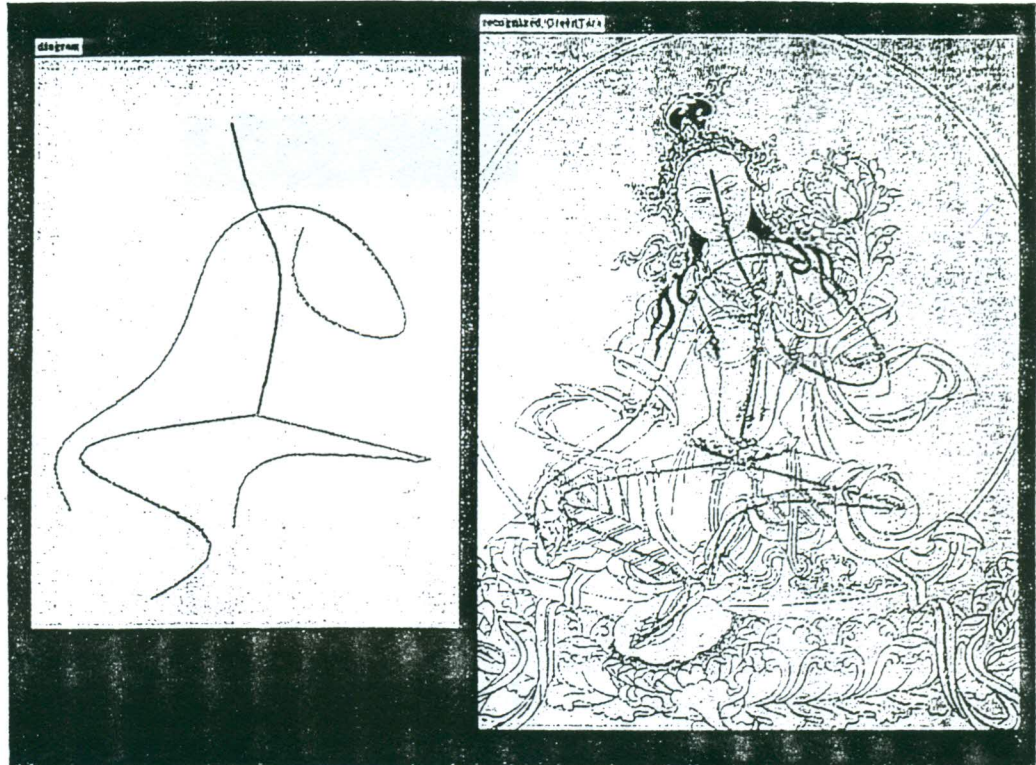


Figure above illustrates a pictorial indexing and retrieval scheme for images, based on the Electronic Sketch Book of Tibetan Thangka Painting Project (Makkuni,

1989b). Derived from the Tibetan iconometry, an image of a Tibetan deity can be specified by a diagrammatic language. A collection of diagrams can represent all

deities' graphic characteristics. Deities are modelled after ritual yoga postures, which are used by the computer for recognition or pattern matching.

passive approach to learning.

Through a sequence of projects conducted over the past decade, we have been examining the question of moving beyond the "passive" methodologies that are characteristic of contemporary multimedia systems. Active learning technologies must provide the learner with forms of access that are appropriate to the content of learning. The goal of active learning is to create increased learner engagement with the content.

The very nature of multimedia content demands interfaces that are non-textual. In order to develop interaction paradigms for information access, indexing, retrieval, and browsing of multimedia content, we will need to re-vision existing paradigms for interaction: non-textual, keyboard-less interfaces that permit creative possibilities for learners. If we can recognize that

literacy is not related to the learner's proficiency in the text media, then multimedia interfaces present an opportunity for learners to think in sound, pictures, and movement, i.e., interfaces that complement textual communications.

Contemporary multimedia technology have undoubtedly increased the display space that is available for authors of multimedia documents to project images and sounds. However, for learning systems, input technology of keyboard and mouse appears to be primitive when compared to the rich display technology. The disproportionate emphasis on the display of pictures and sounds, rather than on the state of the input technology, i.e., mouse and keyboard, raises questions for the learner's hand skills. We must consider the engagement of the learner's hands, more than just the learner's eyes and ears.



The Hypertala project (Roh & Wilcox, 1995) examines the question of how to provide learners with no knowledge of Indian music to experience something of what it is like to play Tabla drumming, and to learn how some fundamental musical ideas are expressed in the rhythms of north India.

As shown above, the learner will sing out, or clap out rhythmic phrases. The system will respond to them with similar patterns which might occur in Tabla drumming. So by specifying simple rhythms, the user can explore variations on the rhythmic cycle and gain an appreciation of how the

underlying structure works in the music. The system provides the learner with a means of creating Tabla sounds, and exploring patterns which are characteristic of Tabla drumming. This music learning system will provide the user access to a space of sound accessible to skilled Tabla players.

Figure 5.  
Sound Browsing Interfaces

## REVIEW OF ACTIVE LEARNING

... Makkuni's exhibit of the Gita Govinda embraces music, dance and literature. To get a sense of how he uses computer technology in the exhibit it is helpful to bring to mind filmcraft, special effects in the movies, the zooming in on pictures and instant replays of televised sports. Zoom into the dancer appearing in a window; freeze frame and slow down. The teacher may highlight the dancer's gesture with overdrawn animations, little colored arrows showing exactly how the bands are moved or how the dancer bows. Instant replay and slow motion make it easier to see slowly what the dancer did quickly. Gestures can be coordinated with other elements so that we see exactly how the music corresponds to the dance, or how the dance corresponds to part of a written story.

A presentation this rich has important implications for other uses in digital libraries. The purpose of Vannevar Bush's Memex was to help master information that had become overwhelming and to enable one information forager or "sensemaker" to make trails for the next. The user could follow the shared trails in the memex to engage in collaboration and make sense of collected information. Makkuni's example transforms the trailmaker into a teacher or master. Here, too, each trailmaker teaches the next. What does the trailmaker leave for his successors? For Bush, it was just a trail. For Makkuni, it is the full range of communication between teacher and student. The teacher gestures, and moves, and presents material. Makkuni's focus on culture and dreams lifts him beyond the confines

of conventional hypertext. He shows us that the tools for teaching in the digital media are more powerful when they move beyond text. In effect, he is creating multi-media teachers. Instead of just putting class notes on the network, Makkuni puts the teacher - or at least the teacher's vibrant performance - on the network.

Why is this important? One assumes that better presentations mean more effective learning. Digital works that are easier to access and understand, encourage people to explore. Moreover, not all readers have the same skills. Might a network of such teachers enable curious non-readers to expand their horizons? ...

Extract from Mark Stefik,  
*Internet Dreams*, The MIT Press,  
Cambridge, Mass., 1996

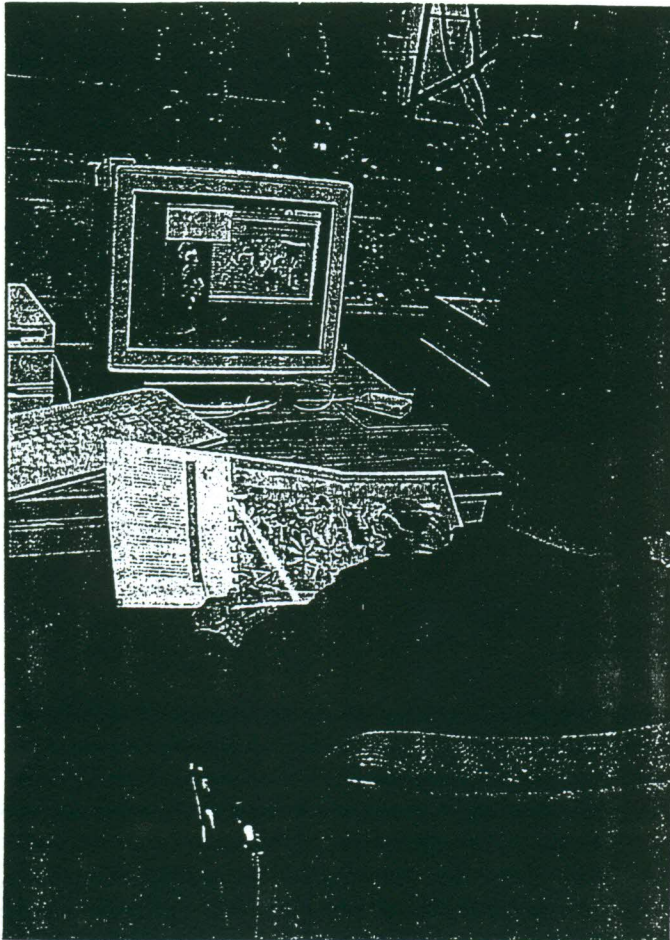


Figure 6.  
Hyperpaper: The Paper-  
Computing Interface

Hyperpaper is a combination of paper media and computer multimedia. Similar to a mouse on a screen, Hyperpaper is used to trigger multimedia information from printed paper documents. Hot spots are printed on the printed

page. A miniature video camera packaged as a pen-like pointing device recognizes patterns on the printed page that encode position information on the page, in turn to play back video recordings in computer multimedia.

## MEDIA SYNERGY

The history of man reveals that technology, like other disciplines, while making innovative strides, has always referred to the past. Just as stone buildings replicated the organic forms of wooden buildings in stone, computing media had borrowed from the forms of paper media. Paper has developed its own cultures of production and use. Initial efforts at computing were aimed at emulating the properties of paper. Instead of redefining paper interfaces in computing, we must explore bridges between the two media.

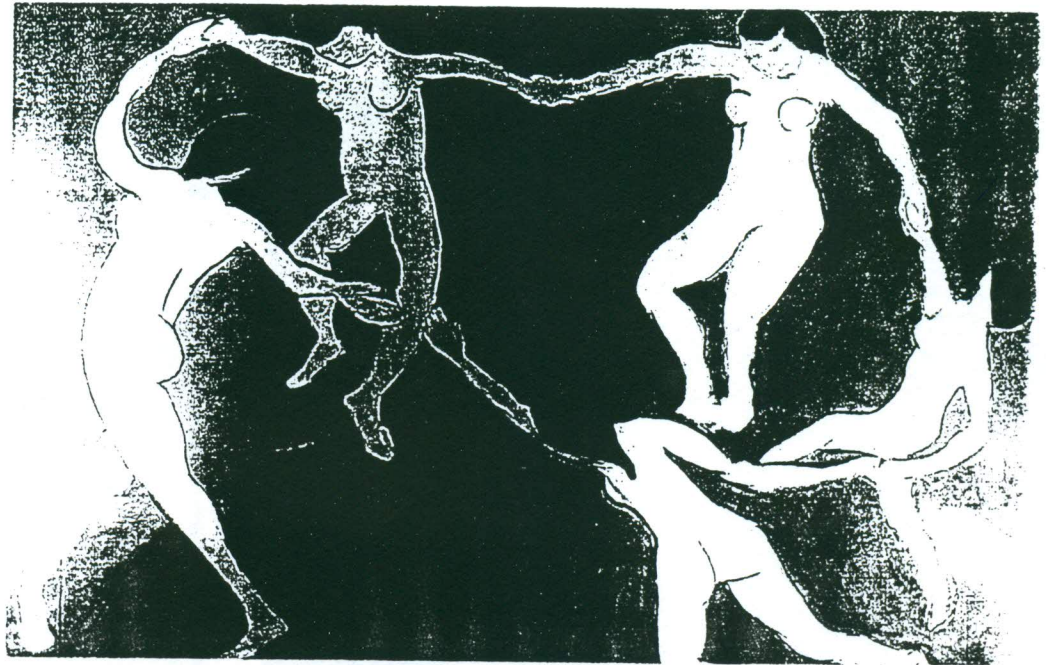
For over a thousand years, aesthetic conventions have been developed for the presentation of content through the composition of text and pictures on paper, book binding, and sleeve design. More recently, an aesthetic has evolved for the presentation of information on computer display screens. Paper offers the user a portable, high resolution, tactile surface. In contrast, the computer typically offers a

cold and bulky glass display surface.

Because of the limited dimensions and resolution of the computer display screen, interface techniques such as windows have been developed to provide the user with partial views of information. Paper, on the other hand, is not restricted by size, and offers the potential for access to significantly more information on a single page.

In the future, there will be a demand for new media which combine the portability, high resolution and familiar tactile qualities of paper with the multimedia playback capabilities of electronic media. We call such media Hyperpaper. We have developed prototypes of paper-multimedia bridge media in which the traditional medium of paper has been used to provide a seamless interface to more dynamic multimedia content (Jared et. al, in press, 1997), thus creating synergy between paper and multimedia cultures.

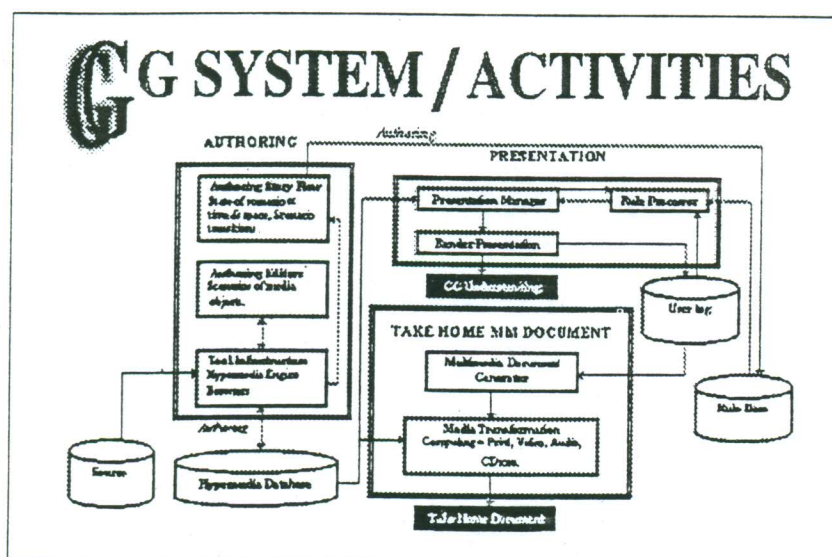




The Thangka and Gita-Govinda projects have developed multimedia museum exhibits, and authoring and presentation tools for cultural learning that have advanced the state of the field. In order to create the multimedia learning tools, the projects created a high performance interdisciplinary team with expertise in both technology and content development, as well as the research and development infrastructure

and work culture necessary for conducting multi-media development.

Therefore, the work practice methods -- in the conception and delivery of pioneering cultural learning applications, development of tools and presentations, development of infrastructure, the establishment of a work culture focused on innovation -- can be applied to creating environments required for innovation.



In this paper, we presented our explorations in the research space of active learning. Present-day learning models and tools will need to be expanded to provide the learner with deeper access to content, as well as appropriate modalities of access. Active learning presents one such re-visioning for multimedia research.

#### ACKNOWLEDGEMENTS Project credits

1. The Electronic Sketch Book of Thangka Painting project is a collaboration of Xerox Palo Alto Research Center and Asian Art Museum of San Francisco. Project team consisted of: Ranjit Makkuni, director; Axel Kramer, software designer; Lama Wangyal and Tai Situpa XII, Tibetan lamas; Terese Bartholomew, Richard Kohn, Molly Schardt, curators of the Asian Art Museum; Mark Chow, Brian Tramontanna, Theron Thompson, Ed Foley, video producers; Rand Castile, Bob Stults, administrative managers; Enrique Godreau, Steve Harisson, David Robson, Karon Weber, Frank Zdybel, multimedia research consultants; Gega Lama and Senge Lama, Thangka consultants. Additional support was obtained from LJ and Mary C Skaggs Foundation, Apple Computer, ParcPlace Inc.
2. Project Gita-Govinda is a collaboration of Indira Gandhi National Center for the Arts, New Delhi and Xerox Palo Alto Research Center. Project team consists of: Kapila Vatsyayan, Gita-Govinda Authority; Ranjit Makkuni, project leader; C. Venkatesh, software designer; Manav Sehgal, software consultant; Papiha Saha, Yatish Jain, graphic designers; R. Sarath, Aribam Sharma, Prithwiraj Mishra, Kamalini Dutt, video producers; Sumita Arora, Amar Verma, Sameer Madan, Subranshu Banerjee, BPS Vadhera, DN Dubey, Manisha Gera, Rajesh, additional project support; John Seely Brown, Jan Pedersen, Jae Roh, Andy Daniels, Steve Harrison, Cecilia Buchanan, Enrique Godreau, Frank Zdybel, Takeshi Shimizu, Eiji Ishida, Doug Cutting, David Jared, Mike Sipusic, Susan Irwin, Sara Bly, Eric Saund, multimedia consultants; Per-Kristian Halvorsen, Néena Ranjan, administrative managers; Barbara Gable, Patricia Sheehan, Reena Rawat, Bhaskarji, Bhuvan Ram, Yashdev Sharma, administrative support.
3. Hypertala project team consisted of: Jae Roh, Ranjit Makkuni, Jan Pedersen, Lynn Wilcox, multimedia researchers; Swapan Chaudhari, Ravi Gutala, tabla drummers; Mike Sipusic, learning theory consultant.
4. Hyperpaper project team consisted of: David Jared, Ranjit Makkuni, David Hecht, Noah Flores, Glenn Petrie, Eric Saund, multimedia researchers; Madhu Khanna, cultural learning consultant; Ved Prakash Bannuji, traditional painter.

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Researcher in multimedia, active learning technologies, has been affiliated with *Xerox Palo Alto Research Center* since 1985.

Makkuni holds M. Arch. in Design Theory from *UCLA*, and B. Arch in Architecture from the *Indian Institute of Technology, Kharagpur*. Makkuni is a sitar student of the *maestro Ali Akbar Khan* in the north Indian classical music tradition.

At *Xerox PARC*, Makkuni presented one of the first uses of computing and video technologies to capture and support the design process – more than just the capture of resulting design artifacts. He later expanded his design activities and, in 1986, he articulated a vision for the supportive use of multimedia technologies in *cultural learning*.

During 1987-1989, he conceived and directed the successful, internationally acclaimed *Electronic Sketch Book of Tibetan Thangka Painting* project, which was exhibited at the *Asian Art Museum of San Francisco*. He is currently leading the *Project Gita-Govinda*, a collaboration between the *Indira Gandhi National Center for the Arts, New Delhi* and *Xerox PARC* to build a multimedia exhibit based on the traditional multimedia art form, the *Gita-Govinda*, a 12th century love poem expressed in

painting, music and dance.

Makkuni's work marks a strong departure from the traditional text-based approaches common to computer interaction, and has been exploring multimedia interaction techniques that are non-textual, through *gestures, sound, and movement browsing* technologies. In 1985, he built a completely *gesture-based, keyboard-less computing system*. Makkuni holds a patent for the *gestural retrieval of multimedia databases*. Makkuni is also a co-inventor of *Hyperpaper*, a paper-based multimedia system that explores the synergies between the traditional paper and modern multimedia media.

Makkuni's publications include papers in the fields of *Computer Graphics, Visual Databases, Computer Supported Cooperative Work, Archeology, Culture and Communication, Design, Education, and Asian Art*. Makkuni is also an upcoming Sitar performer, and has performed sitar concerts in the US, Europe, and in India. Makkuni serves on the editorial board of *Visual Computer*, an international journal of Computer Graphics, and on the Program Committee, *IFIP Conference on Visual Database Systems*.