ICAT 2005
December 5-8, Christchurch, New Zealand

Annotation Authoring in Collaborative 3D Virtual Environments

Rieko Kadobayashi[a], Julian Lombardi[b], Mark P. McCahill[c], Howard Stearns[b], Katsumi Tanaka[a,d], and Alan Kay[e]

[a] National Institute of Information and Communications Technology, Kyoto, Japan. *rieko@nict.go.jp*
[b] Division of Information Technology, The University of Wisconsin-Madison, USA.
{*jlombardi*,*hstearns*} *@wisc.edu*
[c] Office of Information Technology, University of Minnesota, USA. *mpm@umn.edu*
[d] Department of Social Informatics, Graduate School of Informatics, Kyoto University, Japan.
tanaka@dl.kuis.kyoto-u.ac.jp
[e] Senior Fellow, HP Labs, Hewlett-Packard Company, Palo Alto, California, USA. *alan.kay@hp.com*

Abstract

To be generally useful for collaborative research and learning, immersive virtual 3D spaces must include intuitive content creation and annotation tools. We describe some initial work to enhance one such environment (Croquet) for use in a broad range of collaborative applications. Annotations in virtual spaces may include features such as comments on objects in the environment, guided tours through the virtual space, and a history mechanism so that the evolution of objects or portions of the space can be replayed and examined. In general terms, an annotation is simply a relationship between one object and another and we examine several methods of displaying these relationships. To extend annotations across communities, the system architecture supports naming and packaging object and meta-information and integration of content into a shared digital repository. By distributing to users the power to create, edit, store, and retrieve objects and annotations, we promote development and re-use of meaningful content. Such systems can have great utility for the development of virtual environments for learning and research.

Key words: Virtual Reality, Croquet, 3D user interface

1. Introduction

As 3D graphics capable mainstream personal computing devices have become affordable, use of virtual reality environments for education and entertainment is attractive. Virtual reality environments provide a (usually immersive) 3D graphics environment. To move beyond simple eye-candy 3D environments, it is necessary to explore how distributed 3D environments can be made available to users as a tool for object creation, editing, storage, and retrieval in support of wide-scale collaborative communication.

Our research explores ways by which multiple authors can modify Croquet scenes and object by adding content, comments, and references. This is essential to support collaborative research and learning for scholars and students. By exchanging ideas and comments about content, users deepen their understanding and Croquet spaces act as a 3D wiki or blog with community-developed media, content, and commentary.

Croquet, written in Squeak [1], is a combination of open-source software and peer-to-peer network architecture providing an infrastructure for synchronous real-time problem solving within shared simulations [2]. Croquet supports the collaborative creation, viewing, interaction with and sharing of remote objects via a peer-to-peer network of diverse user hardware.

As an ad-hoc multi-user network, Croquet is similar to the web in that users have the ability to create and modify a "home world" and create links to any other such world. Users or groups with appropriate sharing privileges, can visit and work inside other Croquet spaces on the Internet. Croquet's connections between worlds via spatial portals are an analog of web page hyperlinks. Important differences between Croquet and the web are that Croquet is a fully dynamic environment in which everything is a collaborative object, and the Croquet code is modifiable while the system is running.

2. Annotation functions

Annotations may be thought of as author-attributable content placed within a Croquet scene in association with (or reference to) a particular element of that scene. For example, an expert in archaeology may enter a Croquet scene that contains a 3D model of an archaeological artifact in need of some form of commentary. Using scene annotation capabilities, this user should be able to add commentary in association with specific aspect (or aspects) of the artifact. This new content would persist in the Croquet space and be made available to other users as a form of annotation attributed to the author. This new content should also be searchable, so that other users could locate all commentary on a specific artifact or commentary created by a specific author.

To this end, we have developed basic conventions by which annotations can be created independent of the form of media. We allow objects to become annotation even if the object was not originally designed to be an annotation. This is important so that we provide the richest possible set of tools for expressing comments and annotations. Of course users can make a new annotation object using such as text input interface.

2.1 User-defined paths in VR spaces

Collaborative 3D spaces make it possible for authors to not only publish text, audio, video and objects directly within the simulation, but they also make it possible for these elements to be arranged in a particular order within the space. Thus, authorship of information in 3D spaces also includes the arrangement of particular chunks of information. In this way, courses of study can be literalized as paths through a 3D space. We have developed user interface tools that enable authoring of simple paths through Croquet-based 3D spaces by treating the path itself as a series of annotations. By arranging a series of linked annotations in the scene, users may define a path or course through a scene with commentary at each stop on the path. Other users may then identify selected annotations and traverse the annotation path so that a tour of a scene and its annotations that has been defined by one user can then followed by another user or groups of users. These paths might span nested spaces or portals or be confined to a single world.

2.2 Interactor

Annotations that are always visible can result in significant visual clutter. On the other hand, if an annotation is not visible by default, users can easily

overlook it. This means some "Filter" function [3] is needed. We developed "Interactor" which is a viewing screen to allow users to add annotations to the objects and to control the view of annotations. The annotation is visible only in the interactor through which it was made. Each user can have their own interactor, or several users working in a group or team can share an interactor. The interactors can be moved around, and viewing through both simultaneously allows you to view annotations from both sets of authors.

2.3 History viewer

The history mechanism allows for playback of the evolution of a 3D concept map over time. Providing a scrollable timeline for the history of the evolution of the annotations can also act as a un-do feature. The user scrolls back to a desired state and then jumps in to create a new future. Since annotations are objects, users could reveal not just text and graphics, but audio, video, portals to other worlds, simulations, and so on. This gradual reveal is one example of selective information hiding – a necessary technique for managing the complexity of community created content.

3. Conclusions

We have introduced our prototype system on collaborative annotation authoring in 3D virtual environments. We believe that providing functions for making and sharing annotations to the content to the users of the 3D virtual environment will make 3D virtual environment useful for collaboration.

References

[1] D. Ingalls, T. Kaehler, J. Maloney, S. Wallace, A. Kay. "Back to the Future: the Story of Squeak, a Practical Smalltalk Written in Itself." Proc. of OOPSLA, pp. 318-326. ACM Press, 1997.

[2] D. Smith, A. Raab, D. Reed, A. Kay. "Croquet: A Menagerie of New User Interfaces." Proc. of C5'04, pp. 4-11, IEEE CS, 2004.

[3] R. Kadobayashi. "P2P based Collaborative Annotation Environment for Digital Archives." Proc. of the Multimedia, Distributed, Cooperative and Mobile Symposium, pp. 611-614, IPSJ, 2004 (in Japanese).