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Short Presentations

From Textual Chats to Interest Groups in 3D Virtual Space

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Abstract

While the textual chat is a highly popular tool for various kinds of social interactions, its extension to the visual three-dimensional domain remains almost untouched and without practical utilization yet. This paper discusses advantages and disadvantages of spatial virtual environment when used as a platform for connecting people and serving for social and cultural interaction. The differences between textual chat and interest groups in virtual reality are highlighted with the aim to overcome the gap between well-established chat technology and promising but still a bit exotic virtual reality approach. Theoretical analysis is followed by several examples taken from experimental setup.

Categories and Subject Descriptors (according to ACM CCS): I.3.2 [Computer Graphics]: Graphics Systems; I.3.6 [Computer Graphics]: Methodology and Techniques; I.3.7 [Computer Graphics]: Three-Dimensional Graphics and Realism; K.4.2 [Computers and society]: Social Issues

1. Introduction

The motivation for this paper comes from our tests and experience with multi-user virtual reality systems. Concentrating on social aspects of such systems, we have noticed that the virtual reality offers only limited "added value" to popular textual chat. The possibility to collectively examine large virtual environments is used very rarely; the same is true for maintaining interactive actions and changes within group of users. While the paradigm of "chat room" is quite useful for expressing specific interest in chat, corresponding "3D rooms" represent rather spatial limitation and obstacle for free being in a virtual world. The ways to adapt virtual reality scenarios to efficient and natural social interaction and communication are still open and we discuss them in this paper.

The following text introduces methods and habits currently being used in chat programs and virtual reality systems. Basic features of chat programs are presented in the Section 2. Multi-user virtual reality systems are briefly described in the Section 3. The Section 4 contains a proposal for interest groups in virtual reality aimed to social and cultural interaction. Implementation issues are discussed in Section 5. Our experimental environment called e-Agora is described in the Section 6. Section 7 concludes the paper.

2. Multi-user social interaction

The phenomenon of anonymous talking (chatting) with people connected together via Internet is surprisingly strong and popular. Two main streams can be distinguished. *Discussion groups* (e.g. USENET newsgroups) are concentrated on specific topic and users mostly connect to them when searching for detailed information or advice by experts or experienced people. Such discussions are often archived because of valuable previous content. *Chat groups* (e.g. IRC channels) are always on-line. Some of them are also oriented toward certain topic (hobby, sport, culture, etc.), but real content can vary a lot. In many cases, the content itself is not so important – the great thing is to be in touch with other participants, to have audience for one's thoughts, to exhibit one's funny or serious opinions and comments. This kind of social interaction can be of high interest for psychologists, creative people, cultural providers and many others. In the following text we will concentrate on chat groups only.

Internet chatting has among others the following features:

Anonymity
: People do not wish to provide any personal information like e-mail, name or even gender. That is why "serious" programs for cooperation and communication like MS NetMeeting cannot serve for chatting.

Transparency
Instead of private talk one to one, all messages are sent to all connected people. The chat is a kind of a whiteboard where everybody can write a message to all participants.

Creativity
Crazy nicknames often express wishes and dreams of real users.

Expressiveness
Messages can be extended by additional elements highlighting one's mood, a feeling or a position. Well-known "smile" images are available in textual or icon form.

Interest
People interested in the same topic can select *chat room* with predefined subject(s). It is not necessary to talk about that topic all the time, but one can be sure that given topic is at least known to the audience. The chat room represents the only and the basic unit for message distribution.

Structure
The structure is usually quite simple. The given room (marked by specific chat topic) is driven by one supervisor (founder, owner) while other participants have no special privileges. The supervisor can limit the number of participants or kick-off/mute an undesirable person.

It seems to be highly probable that all those features together make the chatting on Internet such successful and widely acceptable.

3. Virtual space

Virtual reality (VR) systems allow for real-time visiting, navigating through, and interacting with three-dimensional (3D) scenes. In multi-user VR systems, each user is represented not only by (nick)name like in chat but also by a virtual human called *avatar* [1] (see Figure 1). A user's activities are transformed to avatar's movement, thus models of avatars have to be dynamic. When a user navigates in virtual space, other users see, how his/her avatar is translated, rotated or even fully animated.

Several multi-user VR systems are available on the Internet, e.g. Active Worlds [2] by ActiveWorlds, Community Place [3] by Sony, DeepMatrix [4] by Geometrek, or Atmosphere [5] by Adobe. One of the most successful is *Blaxxun* [6] that is taken as reference software in this paper. It aims to social interactions in 3D and contains many features similar to chat programs. The most important are:

Gestures
A user can express his/her feeling by selecting from several predefined gestures. "Smile icons" are represented by "body alphabet" in 3D. Users can create own avatars and their gestures. Few examples are shown in Figure 2.

Textual and audio communication
The textual chatting plays still very important role. A text window is always presented in application. Moreover, the text can be automatically converted to speech. To speed up a typing messages, user defined text macros are available.

Structure
The whole 3D virtual space is subdivided into regions, either closed (rooms in interior scenes) or open (streets and squares in urban scenes). All activities are limited to one region, i.e. messages are distributed to people presented in current region only. A user can simply teleport to another region/world, but looses all communication running in the previous one.

There are two different reasons for using regions. Firstly, a region limits the number of avatars, thus decreasing the network traffic when distributing avatars' activities. It also uniquely assigns a user to certain chat group. The second reason is done by technological limitations – only relatively small 3D scene can be rendered in a real-time and can be transmitted from the server to a client in reasonable time. Thus the virtual worlds have to be structured in regions that are maintained independently.

Figure 1: *Various avatars help users to express their individuality – either real or wishful*

Figure 2: *Some gestures – agreement, sadness, excitement, neutrality, happiness, disapproval*

The interesting fact is that the Blaxxun system can be directly used for "classical" chat without any 3D information. When users have not enough computational power or network bandwidth for rendering 3D data, they still can join the textual chat in already existing virtual worlds. This approach is used at *www.cybertown.com*. Text and VR chat co-exist there and the question "*Is VR able to markedly enrich text based social interaction?*" appears again, since many users still prefer text chat, although now-a-days computers are equipped with sufficient software and hardware support for Internet based virtual reality.

Table 1 shows main differences and common features of both approaches under discussion. The concepts in the table are not bounded to Blaxxun only.

Feature	**Text**	**Virtual reality**
Anonymity	Full	Full, but the visible existence of avatars can be perceived negatively (too many avatars in a space, avatars too close to a user, strange gestures etc.).
Number of participants	Tens, unlimited	Reasonable number is about 25. Too many avatars cause crowds in virtual rooms. High number of avatars cannot be rendered in a real-time.
Expressive-ness	Smile icons	Smile icons plus gestures, animation of avatars.
Media	Text, audio	All kinds of media can be presented in virtual environment.
World	Board for text messages	Full range of 3D objects plus media.
Interactivity	None	Possibly unlimited, but not widely utilized in current systems. Results of interaction (e.g. switching colored light) are visible by all participants.
Group activity	Not applicable	Not used, although possible (e.g. virtual orchestra with individual musicians).
Interest	By a room	Currently by a region, better by an interest group (see proposal in the next Section).
Bounds of communication	By a room	By a region in current systems. Theoretically no bounds are necessary and chat group could communicate across many virtual worlds.
Shared experience	Text sentences	A group of users can visit an interesting virtual room or play virtual game, etc. Arbitrary data could be uploaded and presented by an individual user to other participants (image on the wall, web page on the board, movie on the screen, 3D object on the table).

Table 1: A *comparison of text chat and multi-user VR*

The virtual reality seems to be at least as good as textual chat in almost all cases. The only exception is the lack of feeling of independency and limited number of users as seen in first two items in the table. All other features typical for social communication and interaction can be very well supported in virtual reality (when we do not care about graphics hardware and network bandwidth required).

In the following section we propose to consider chat groups as *interest groups* in virtual reality. Such interest groups should be maintained in different ways than in current multi-user VR applications. Since the relatively small number of participants represents an impassable limitation in VR, we should concentrate on removing all other barriers like spatial limitation done by regions or communication limited by one room. We believe that the potential of VR for social interaction is strong enough and the main problem is how to utilize it in a proper way.

4. Interest groups

This section proposes base principles for creation, maintenance and use of interest groups in distributed virtual environments. The *interest group* represents a unit with limited number of anonymous members communicating via Internet, sharing and interacting with 3D space, viewing each other, and using various navigating paradigms when exploring virtual environments. Members of interest group have a feeling of commonly shared space, time, and activities.

4.1. New navigation paradigms

Navigation in desktop VR applications is often considered as a little bit strange, since the conversion of 2D input taken from a mouse or a keyboard to the movement in 3D is definitely not natural. This barrier can be partially overcome by *viewpoints* allowing users to be moved to a predefined position. Viewpoints help not only to simulate walk or fly but also to shorten big distances when examining large virtual area. Static viewpoints can be simply enhanced by animated ones thus simulating guided tours.

Multi-user virtual reality offers a new utilization of viewpoints. Positions and orientations of each participant represent additional, dynamically changed viewpoints. Such viewpoints are distributed to others and are used for updating positions of corresponding avatars in current systems. A new idea is to provide dynamic viewpoints directly to arbitrary user and let him/her to use them as regular ones. This approach brings a new navigation paradigm – *dependent navigation*. In contrary to a real life, dependent navigation in virtual reality allows the following activities:

- Immediate jump to a position of other (distant) user. A copy of data taken from the dynamic viewpoint of somebody else is used for setting dependent user's current viewpoint. This approach is known as "*Look at (somebody)*" or "*Talk to (somebody)*" in already existing VR systems. A new viewpoint is typically further transformed relatively to distant avatar's position so both avatars finally stay opposite each other with the distance of a few meters. If the distant avatar examines different virtual world, new 3D data have to be sent to a dependent user, too. Due to this fact, most of current systems limit this navigation method to be used within the same 3D scene only.
- Continuous update of user's viewpoint by connecting with the dynamic viewpoint of distant user. We call this principle as "*Watching the world through tutor's eyes*". It allows to passively watch the virtual environment and to be driven by experienced person – *a tutor*. Generally, all activities of a tutor (distant avatar) can be distributed to other users, e.g. interactions with a virtual world. A dependent user then see how the tutor interacts with 3D environment, because all tutor's interactions are simulated by dependent user's browser. The result reminds of replaying movie that is created using real-time and on-line activities. This approach is quite rare in current VR systems, although it seems to be ideal for distant learning and practicing in a VR.
- Continuous update of dependent user's position with specific geometrical offset. This method is similar to the previous one, but the dependent avatar is placed to slightly different position than the distant avatar's position is, e.g. one meter backwards or even half a meter upwards. The principle is useful for the function "*Follow me*", when dependent user wants both to follow a tutor and see his/her avatar. A simplified version of this navigation paradigm is already implemented in Blaxxun and it is known as "3rd person view". In that case, the offset is applied to separate the position of user and a position of his/her associated avatar, i.e. a user can see his/her own human body representation in 3D space. At present, the 3rd person view is not applicable to another avatar.

Simple, efficient and straightforward navigation is one of the key points in virtual reality. While in single user VR systems the navigation deals with three subjects only – a user, an avatar and a virtual space, multi-user systems offer much more combinations as seen in the listing above. Most of current systems utilize a navigation based on avatar-to-avatar relationship only. Generally, the navigation could influence a group of users as well. Taking the principle of dependent navigation into a consideration, we can talk about *individual*, *couple* or *group* navigation and activities. The step from couple to group navigation is simple – the relationship between a distant avatar (a tutor) and a dependent user can be formalized with the following rules.

Let d(U1, U2) denotes a navigation mode where a position of a user U2 depends on position of a tutor U1. Then the following rules apply for composition of dependent navigations d:

1. $d(U1, d(U2, U3)) = d(U1, U2)$ & $d(U1, U3)$
2. $d(d(U1, U2), U3) = d(U1, U2)$ & $d(U1, U3)$

The first rule represents a situation when a tutor U2 with one dependent user U3 links up to a new tutor U1. Then both users U2 and U3 start to be dependent on U1 – positions of their avatars are updated upon position of avatar U1 and the previous relationship between U2 and U3 is cancelled. The second rule is used when a user U3 links to already dependent user U2. Again the composite dependency is split into a set of single dependencies. Note that those definitions represent one possible solution only. One can imagine complex relationships among users, e.g. holding hierarchy of dependencies. Proposed solution is simple for the sake of implementation – the propagation of all viewpoint data is reduced to bilateral arrangement. Rules are complete in the sense that the cyclic dependency is automatically resolved – a term *d*(U1, U1) is considered as empty relation.

Group navigation can play an important role in social aspect of interest group. When the 3D virtual space consists of big number of rooms, places, and other interesting virtual scenes, active users can examine different regions (for instance separate exhibitions in virtual Louvre) and then invite others (to commonly visit and discuss Art of the 18th century). Users can freely switch between passive (dependent) and independent mode. The proposed principles are well suited for common visit of virtual cultural events, exhibitions, architectural presentations etc. The scenario then reminds of playing multi-user "*adventure*" game. If members of one interest group are spread in many virtual worlds, the system must ensure automatic uploading of 3D data to dependent user(s) identical to the data examined by a tutor.

The dependent navigation is a feature possible in virtual environment, not in a reality. Here the VR technology really brings an *added value* to the communication and common experience of participants.

4.2. Shared experience

In a social interaction, users often want to show something interesting to other participants – an image, a web page, mp3 sample. While this is not possible directly in textual chats, virtual reality incorporating various media can serve for such purposes very well. Here we can utilize a paradigm already used in applications like MS NetMeeting. A common space known as *board* allows painting on the area that is shared by other people. More generally, shared board is the universal chat-board, where any kind of object can be placed and made accessible to others.

We propose to establish two kinds of shared boards – *group* and *personal*. Group board is just one for the whole group, while personal boards are attached to individual participants. The group board serves for data presentation and exchange among all users – everybody can add/remove/change the object(s) on the group board. Each personal board belongs to one user and he/she maintains it with the aim to show own data to other group members. The owner of personal board can hold the content read-only or to permit another kind of access to other users.

Next important thing for the illusion of common acting within the shared virtual environment is the propagation of interactive events to all users. The *state* of all virtual worlds visited by particular group of users has to be stored in a central storage place and used whenever any member enters one of those worlds. This principle is known as "*updating a state for a late join*" and represents also a base requirement for sharing interactions within the interest group.

The example is opening a window in a virtual scene. When the first user opens a window by clicking on it, this event has to be distributed to other users presented in the same scene (room) and their browser immediately opens the window in their copy of the scene. Users are permitted to leave that room so the browser will release all relevant 3D data, but when they return back, the window has to be still open, although the virtual world has been re-loaded from the server. Stored internal state of the virtual world updates the initial state of the scene. In general, this approach enables distributed editing 3D data. It also allows starting for example a virtual chess game in one virtual room, leaving it and continuing after examining other virtual spaces.

All group activities have to be handled consistently, with respect to a shared perception of commonly visited space. Note that the shared state is the property of a group. Other interest groups can visit the same virtual environment, but they all find that window in question closed. Group activities are hidden to other groups but they are performed across many worlds.

4.3. Creativity

When people start to enjoy 3D virtual worlds they soon wish to create their own objects, starting from the color of the hair of their avatar and ending with their own interactive virtual house. Unfortunately, these requests are not easy accomplishable, since newly created object always have to fulfill certain design criteria and limitations. The more universal and complex multi-user system, the more rigid rules have to be kept. The use of all–purpose design tools and editors is very limited. The best solution is to provide special software tools that generate output fully compatible with the whole multi-user VR system. Another possibility is to create converters from general data formats like VRML and to check specific syntax and additional rules.

To satisfy users' creative ambitions, the VR system should offer at least one of the following possibilities:

1. Creation of own interest group. Similarly like in chat programs, users should have a chance to define new group and specify its name/interest.
2. Creation of own avatar. The minimal requirement is the selection from predefined set of avatars and/or changes of their sizes, colors, and textures. Current systems often accept 3D models of avatars created using external editors (eg. AvatarStudio [7]), but rarely check their technical characteristics like rendering complexity or size.
3. Creation of virtual objects. Similar troubles arise like in the case of user-defined avatars. Interactive virtual objects and whole scenes must be designed carefully with respect to a structure of the system that is responsible for maintaining internal state of virtual space. While static scenes containing geometrical data only are acceptable without problems, interactions have to be carefully linked to a system,

since their distribution is essential for sharing the group experience.

5. Technical solution

To provide members of interest group with the feeling of shared space, time and activities (as specified in section 4) the current state of the multi-user VR (MUVR) system has to be shared by all members (*shared state* [8]). We made an attempt to formalize the distribution and synchronization of the shared state among MUVR members by designing and implementing the concept of *general variables* [9]. The implementation of the concept employs client-server model, which is preferred over the pure peer-to-peer architecture for storing the shared state in MUVR systems. The key principle of the concept is depicted on the Figure 3.

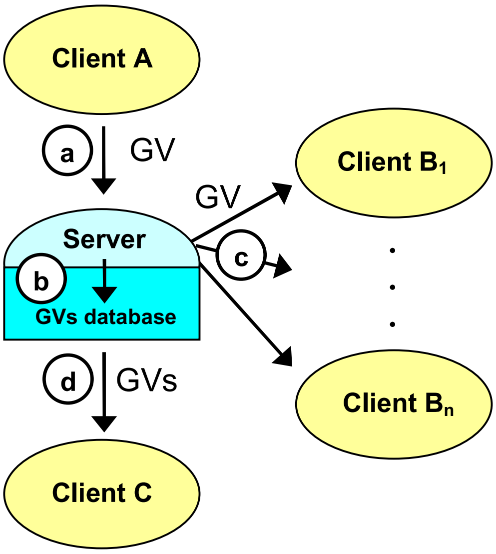

Figure 3: *General variables (GV) concept. Storage and distribution of general variables. a) sending a GV to the server, b) storing the GV in the GVs database, c) forwarding the GV to connected clients, d) sending the GVs database to a late joined user.*

When a user attempts to interact with the world, the client application creates adequate variable containing a value representing the user's action. The variable is then sent to the server, which updates the GVs database and broadcasts the variable to other connected clients. These clients should decode the meaning of the variable and replay the original action locally. If a new client (*late join*) connects to the system, the server sends it the content of the GVs database so that the late joined client can update its state promptly.

While the concept covers the data distribution and synchronization, the concrete meaning of the data stored in general variables is left up to the application. Thus, the general variables can represent user interaction and modifications within the virtual environment, properties of the users (avatar, nickname, position) or specific data like relationships among users (tutor/auditor as stated in section 4.1.).

It is obvious that not every change of the shared state is of particular interest for every user. Furthermore, if we consider one server maintaining several interest groups, the presence and activities of the user (interaction or modifications of the VE) should impact only members of the group that the user belongs to (4.2.). Similarly for efficiency reasons, the users in a room do not need to be informed about activities of the users in a neighbor room until they enter it and learn all changes since their last visit. This technique is referred to as *interest management* in MUVR systems. We decided to unify our interest groups approach with interest management techniques and we proposed a general way to allow users to express their interest in some part of the shared state only. The key idea is to partition the shared state (represented by general variables) into *domains* and *sub-domains*. The domains represent categories of areas of interest (interest groups, regions, navigation, chat or game playing). The sub-domains represent concrete areas (particular group, room, chat theme or specific game). Any state variable can belong to any number of domains that define the scope of the variable. For specifying users' interest we partially adopt the general aura-nimbus interest management model [10] and extend it by including security issues as well.

6. Experimental setup

To verify the proposed idea of interest groups we have integrated the concept fundamentals in our public MUVR testbed system e-Agora [11]. The system is primarily oriented at social interaction; users represented by avatars meet up in the virtual environment and communicate by chat and gestures. The future of e-Agora is quite ambitious; plans exist to connect a number of cultural centers around Europe and build one joint virtual house of culture, where people get together, play, communicate and view culture content (performances, concerts, exhibitions, etc.) in VE online.

6.1. e-Agora architecture

The rendering and networking part are two main components of a MUVR system. e-Agora uses VRML standard for describing the virtual environment and freely available Cortona VRML browser is used to render the scene. The networking part of the system is based on the GV concept implemented in Java.

This architecture implies the separation of geometric VRML data describing the initial state of the virtual environment from the data describing its actual state. While the initial VRML data can be fetched from an arbitrary URL (either from network or even local disk), the actual state of the environment is obtained from a particular GV server that maintains the interest groups and their shared state.

This separation of interest group tied data from initial VE description is consistent with e-Agora future plans, where the scenario is proposed as follows. Several European culture centers will provide and maintain models of their culture centers online. The users will connect to their preferred GV server, choose an interest group and travel together across these virtual centers, explore them and share the experience. This scenario is analogous to the IRC where a user connects to an IRC server and joins a channel to chat with other users.

Currently one culture center (Akropolis in Prague) has been modeled. The model consists of several VRML scenes that correspond to enclosed spaces (concert hall, bar, restaurant, etc.). Next, we provide one GV server that maintains tens of interest groups. To reduce network bandwidth requirements, VRML files describing static parts of the model are stored locally. Only changing parts (exhibitions, etc.) are downloaded over the Internet.

Figure 4: *A tutor in e-Agora (the avatar on the right side) and metaphor for dependent navigation of two users. Animated virtual body in the left bottom corner represents an avatar of local observer.*

Navigation paradigms mentioned in section 4.2 are currently subjects to experiments. The problem lies in designing suitable representation of dependent user, whose position is continuously updated as the tutor navigates through the scene. Some preliminary results are shown on Figure 4, where avatars of dependent users are replaced by lightweight model of winged heads, which are hovering behind the tutor's head. This metaphor provides natural visualization of the tutor and the ability to interact by mouse-click with particular dependent user is still preserved.

7. Conclusion

We have shown that the textual chat can be extended into a spatial virtual environment thus enabling much more richer interaction and social/cultural experience. The transformation from textual to visual presentation requires new paradigms. Chat rooms cannot be represented by 3D models of rooms or other spatially closed areas but rather by interest groups moving freely within unlimited virtual space. New social paradigms like watching the world through someone's eyes or sharing someone's movement activities have been introduced in this paper and presented on experimental application e-Agora.

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