Accessing Libraries as Easy as a Game

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ABSTRACT
One main idea when developing user interfaces for digital and hybrid libraries is to make use of real-world metaphors. This gives library customers the advantage to access digital collections the same way as they would traditional collections. However, while existing "real world" library interfaces still miss the attraction of the wider public, game industry is very successful selling virtual reality games. In this paper we describe a study how to close the gap between these two worlds. We describe the development of a library interface that bases on a commercial computer game. The interface models the interior and exterior of an existing library building including the most important functions for literature search. Not only teenagers tested the developed prototype with big attention.

Keywords
library interfaces, computer games, real-world metaphors

INTRODUCTION
Current research in the development of user interfaces for digital and hybrid libraries aims in finding new and appropriate ways to access and present large collections of digital and non-digital documents. One idea is to provide graphical user interfaces using real-world metaphors so that library customers can access digital collections the same way as they would traditional collections. Very sophisticated solutions already exist; however, they still lack a wider audience. On the other hand, computer game industry - following different aims - manages to attract people with virtual reality environments.

Game industry is especially successful among teenagers and young people. These are exactly the groups libraries have a special concern to educate and lead them to work with books and documents. Politicians and pedagogues complain that teenagers and young people prefer sitting in front of computer games than books; libraries treat computer games as a threatening of their existence.

Maybe a better idea than to complain about the success of computer games (and other products of the leisure industry) and the change in spare time culture is to accept this and find own solutions how to offer real alternatives for young people. This way, a 'serious application' that is supposed to attract young people must keep pace with the pleasure level dictated by leisure industry.

Existing 'real world' or 'virtual reality' interfaces for libraries are often accused to be slow, or difficult to operate, or to have an unattractive look. Although the authors of this paper do not agree with this statement, modeling virtual worlds is one point where developers of 'serious applications' can learn from developers of computer games. A very successful branch of computer games - 3D action games - allow the player to walk through virtual worlds, indoor and outdoor, and show these worlds precisely from the player's point of view. The player has the illusion of walking through the world himself/herself and is faced with the same adventures the game figure has to overcome. This way, 3D action games already have found solutions to present those things developers of visual interfaces for application programs need: Buildings with several floors, elevators and stairs, doors, rooms with chairs, tables, and furniture, view screens, moving objects, transparent objects, and, very important, build-in communication protocols. Many games are available for different operating systems and hardware platforms.

The question is whether it is possible to use the capacities of existing computer games for the development of 'serious applications'. In order to give a hint for the solution of this question, this paper will present a graphical user interface for library access based on an existing computer game. The prototype has been shown to different user groups. Their satisfaction and their comments can be used as a measure for the goodness of such a 'game interface'.

For our experiment, we have selected the game Quake II, produced by id software (http://www.idsoftware.com).

The work presented in this paper is part of the Modern (M)art project (Modeling, Experiments, and Simulation in/with Information Markets). In this project, we want to investigate business models, business strategies, and customer behavior in the application domain of scientific literature markets. Modern (M)art is an interdisciplinary

research project at the university of Karlsruhe, encompassing the department of computer science, the department of economics and business administration, and the university library. It is funded by German Research Foundation (DFG) as a part of the national strategic research offensive "Distributed Processing and Delivery of Digital Documents (V^3D^2)".

We continue as follows. In the following section, we will discuss shortly the objectives of our real world interface. Then we will take a deeper look in the implementation of our 'level' and the modifications we have done on the game so that it can be used as a library interface. Then we will describe in which way our interface is suitable for library access. In the following section, we will shortly discuss preliminary results of demonstrations and experiments with different user groups. Then we will give an overview on some related work in the field of real world interfaces for digital libraries. We finish this paper with a conclusion.

Figure 1: Entrance of the university library in Karlsruhe

OBJECTIVE

Practically all library interfaces that can be found all over the world are text-based. While first generation OPACs are being removed by Web interfaces, these new interfaces are often ergonomic and colorful, but queries still have to be formulated by filling our text forms, and results are presented in result lists. In practice, the way of result presentation is dominated by the capabilities of the HTML table construct.

Most people agree that in general figures and graphical information are more suitable to present information to human persons than pure text. Especially for young people it is important to have an attractive design, in order to fulfil their expectations in regard of "modern look and feel". But although there are solutions for graphics-based user interfaces for libraries, text-based interfaces are prefered. The problems with graphics-based interfaces is that

- they are slower than text interfaces;
- they enforce higher technical resources;
- people have learned to use text interfaces and now can use them very efficiently;
- people shy to use other ways when they cannot see the advantages at a glance;
- people often are not able to operate with the new graphical interfaces, because they are confronted with totally new requirements of interaction;
- they are not wide-spread.

One approach in interface design is to confront customers with things they already know (or at least which look familiar). This approach prevents customer to become deterred by an unknown technology. Interfaces following a real-world metaphor try to model existing worlds or worlds that look similar to existing structures. A world can be a room, a collection of rooms, a building, or a complete city. The idea is that the customer, who knows how to deal with objects in the real world, will be able to do this the same way in the virtual world.

For the designer of a library interface, the challenge is to model a library with possibly most of the very different services associated with such institution. The objective is to offer an access to the services and collections, which is not treated to be exotic, but a better alternative for the usual text-based interfaces, at least for some user groups.

In this paper, we present a real-world model of the university library in Karlsruhe (figure 1).

IMPLEMENTATION

Quake II is a 3D action game, sometimes better known as egoshooter. The aim of practically all these games is to find the way through virtual worlds, kill all resistance, and, in the end, save earth. Some pedagogues worry about the high level of aggressiveness that is necessary to win this kind of games, and call into question the mission that can be learned in these games: solve all problems with the gun.

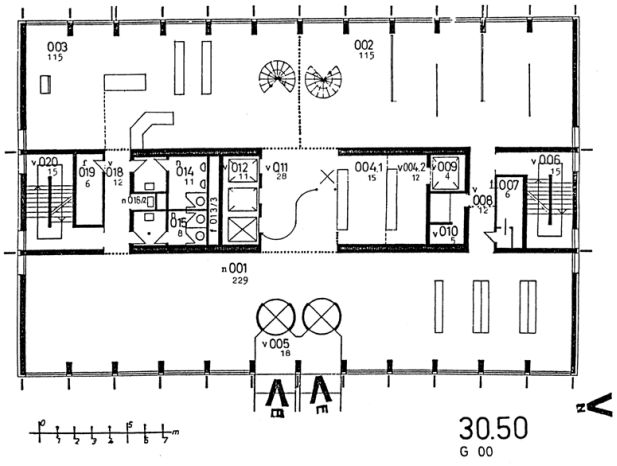

Figure 2: Ground plan of the library building (ground floor)

The authors of this paper see the danger that lies in this kind of games, too. Because of this, one of the first decisions made was to remove all traces of violence from the library interface. There are no enemies and no monster, and also there are no weapons and no armory. In order to retain the metaphor, the user now holds a laser pointer, which really looks fearful, but is completely harmless.

Quake II easily allows to add new virtual worlds by specifying a new map. This map contains the look of the new world, the inhabitants of this world, and also dynamic events that can happen in this world, e.g., a door opens or an earthquake starts. It is important to remark that maps in Quake II are always 3-dimensional. It is necessary to consider the height of an object. E.g., a player standing on a bridge has a different view than a player standing under the bridge. And, of course, one and the same building may look different from one floor to the other.

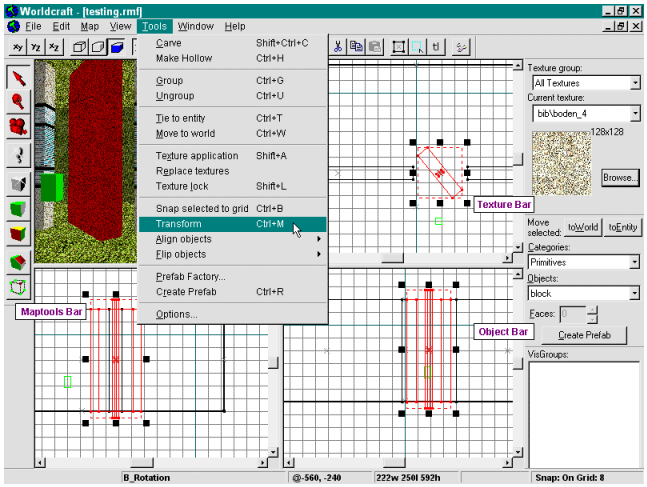

Figure 3: Drawing up the map

We began modeling the interior and exterior of the library building beginning with the original building plans (figure 2), using the map editor Worldcraft by Ben Morris. This level editor allows the construction of a map in all details (figure 3). Floors, ceilings, walls, windows, wardrobes, tables, doors can be grouped to rooms, and afterwards they can be equipped with more pieces of furniture. Several rooms put together become buildings. And, of course, it is possible to construct the world outside the buildings. It is necessary to distinguish brushes and entities. While brushes are always static (e.g. walls, stairs), entities can have a dynamic behavior (e.g., doors, persons, light sources). Dynamic objects need special care, because it is necessary to specify the behavior in detail. Doors are a good example: Are they supposed to open automatically when a player comes near or is it necessary to press a button to open? How fast will they open? Will they close automatically? What happens if they close and a player stands in between?

After completing this first step of the design, we had a correct model of the geometry of the library building. However, the result did not look very close to reality, because all colors, material qualities, and light sources were wrong (figure 4). The next step was to model the textures of the objects: wallpaper, floor covering, material and painting of the furniture. In order to get an image from the reality as close as possible, we made digital photos from the whole building and extracted the textures of all objects.

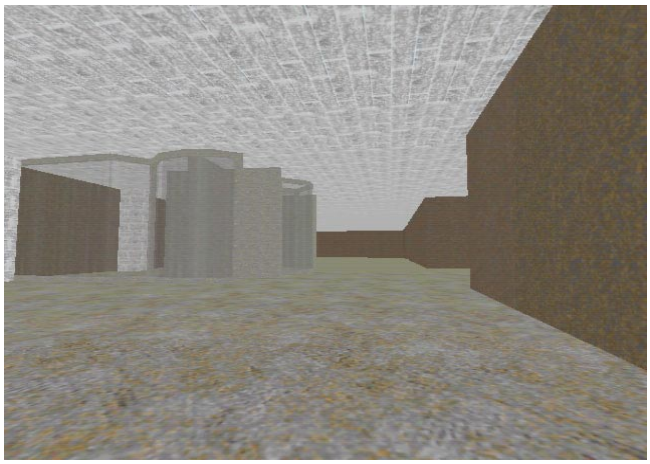

Figure 4: Library map with default textures

The next problem was that we had to model objects that were not contained in the game, or at least not with the necessary functionality, e.g., coat racks, lockers, computers, and, of course, books. However, it is possible to add these objects as so called models. We used the tool 3D Studio Max by Discreet Software to construct the needed models. For each model it was necessary to specify in detail how the object looks when viewed from different directions and from different distances.

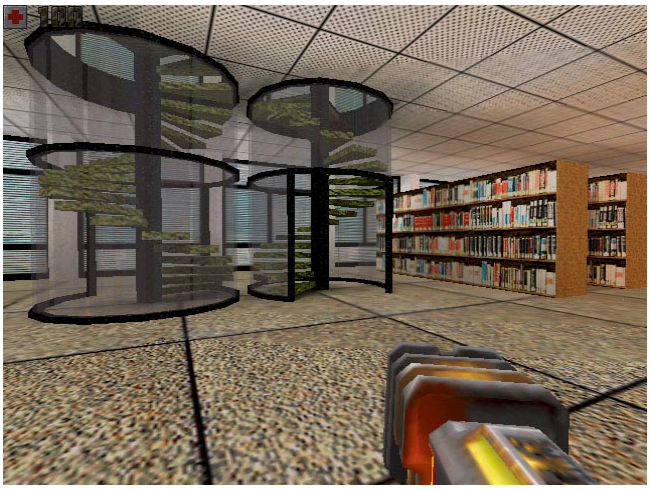

Figure 5: Interior of the university library in Karlsruhe

Next we had to add light sources (which behavior had to be specified), light effects, and sounds. And, of course, we had to define the look and function of the laser pointer. All this was possible using the map editor without writing any single line of code. The result can be seen in figure 5.

Unfortunately, for a more individual adaptation of the game, so that it can work as a library interface, it was necessary to touch the source code of the game. For far-reaching modifications on the game that cannot be done by adding maps, modules, and sounds, id software allowed to edit and re-compile the part of the software that contains the game logic. In the Microsoft Windows/Intel version of the game, this was contained in the file game.dll. The source code is written in C programming language.

For example, we had to extend the functionality of the revolving doors. Quake II offers by default a manifold of possibilities how revolving doors can operate. What we had to add is maybe the most common way: A person pushes against the door, and the door turns. Similar with elevators. It is possible to make an elevator operate automatically, it is possible to have some switches or keys somewhere in the building, but the game developers did not cover one case: that there is an array of buttons inside the cabin, and when pressing a button, the elevator moves to the floor associated with the button. We added a new elevator control.

Figure 6: Interior of the university library in Karlsruhe

Most challenging, of course, was the communication with the library agent. Same as in the real library, it is possible to send a query by filling out a form using one of the computers standing in the library (figure 6). The modified game logic will open a TCP/IP connection with the library agent and wait for the answer. As soon as the answer arrives, the user can watch the new bookshelves be filled with books that represent the documents contained in the result list.

There are some limitations of the game engine, which we could not resolve. E.g., it is not possible to define curved surfaces, only approximations by polygons. It is possible to define transparent objects, but these are not allowed to move. It is not possible to display more than 256 colors, which really spoils the impression of reality. Moreover, it is not possible to display more than 128 movable objects at the same time. Since every book must be movable, this is a strong limitation of the size of the bookshelves.

FEATURES

The most important feature of our prototype implementation is literature search, covering different collections and libraries. Results can be ordered by collection, availability, publication year, and language. There are different ways to distinguish books: by different bookshelves, by the color of the book, and by different labels on the back of the book. The user can dynamically change the assignment of shelves, colors, and labels. The thickness of a book is permanently associated with the number of pages.

Figure 7: Browsing a collection

The user can select a book standing in a bookshelf according to the metaphor by “shooting” on it with the laser pointer. For a selected book, short information is displayed on the bottom side of the screen (author, title, publication year). A second shoot, and display changes to full information. A third shoot could automatically fill out the lending form, but this feature is not yet working. It is possible to browse a collection by simply move along the shelf with the laser pointer (figure 7).

One important feature of most 3D action games is the multi-player capacity. Quake II supports a client-server-architecture that allows several persons to share the same virtual world, connected by Internet or by a local network. The number of person that can be in the virtual library at the same time is limited by 64. Every user sees the virtual world from his/her own point of view and is able to talk with other people (talking is not necessarily limited by the people standing in one room, since Quake II supports a kind of radio transmission). Every user has his/her own inventory, but also the possibility to exchange objects with other people in the virtual library. Gender and look of the virtual library user can be selected before entering the library. It is also possible to write models for the individual users so that every user can specify his/her own look.

There is a large number of services in the real world that can also be found in the virtual world, although our prototype implementation does not include all of them:

- information and issue desks, where the user can receive assistance and information about the collections and his/her account;
- personal workplaces, where the user can deposit books and make notes and annotations that will be saved when the user leaves the library;
- group workplaces that can be used by more than one person;
- virtual librarians who can be played by real librarians or automated by the computer;
- access restrictions by intelligent doors, e.g., for the access to collections which are only available to registered users, e.g., special databases;
- rooms prepared for the presentations of geographic documents (such as maps), video clips, or sound files;
- bulletin boards for information interchange.

It is also possible to add instructions to the interface that tell the user to go somewhere or do something in a pre-defined order, e.g., for a new user. This way the library interface could be used as a tutorial for the use of itself.

ACCEPTANCE

In the introduction we have said that teenagers and young people need computer programs and user interfaces that are more attractive in their minds than the traditional interfaces. In order to find out what young people think of a game interface for accessing library collections, we visited schools and showed the prototypes to pupils of the upper classes, and we also used information days for pupils to invite school classes to Karlsruhe university. The test person were not pre-selected in any way, and they had no previous experiences in the library interface.

The interest of the young people was higher than expected. One significant observation was that the young people followed a "play instinct". Without further assistance, they began to explore the virtual world, and after a while they also began to send sample queries to the library system. They learned very fast how to navigate through the library building. Most of them seemed to have previous experiences with 3D action games (and recognized the underlying game engine as Quake II), others learned the most important keyboard controls by themselves or with some tips from classmates. We could not notice any significant differences between the behavior of boys and girls. Nobody complained that there were no monsters in the library.

Adults (school teachers, library visitors) also showed interest, but their behavior was somehow different. They did not have problems with navigation and use of the library interface, but they used the interface more goal-directed and less exploring. All showed surprise that the world on the screen really resembles the library building. Some test persons had a negative opinion in advance because of prejudices against computer games.

One interesting target group we have hardly touched until now are people who have less experience with computers and Internet. We hope a real world interface will make it easier for them to use library services electronically.

We plan to repeat these acceptance test with the larger number of test persons and in comparison to other library interfaces. From more elaborated experiments, we do not only want to receive qualitative statements, but also quantitative measurements. Of special interest for us is the question whether there are dependencies between the acceptance of different interfaces to social parameters like age, gender, formal education, experience with computers in general, experience with computer games, and experience with library services.

RELATED WORK

Quake II is far from being a standard tool for the development of virtual worlds. More common tools and languages are:

- Java 3D by Sun Microsystems (http://www.sun.com) is written in pure Java and this way platform-independent. Java technology makes it also possible to view Java 3D applets with a standard Web browser. Java 3D is a package of classes and interfaces that can be used in own Java programs. Developing worlds with Java 3D needs the ability to model a world in the abstract view of a scene graph.
- Open GL (http://www.opengl.org) has been published by an industry consortium and has become an industry standard for 2D and 3D graphics. It is available for various programming languages, operating systems, and hardware platforms. It allows the definition of graphical objects as composed of groups of vertices (points, lines, polygons), having different properties.
- VRML (Virtual Reality Modeling Language) by the Web3D Consortium (http://www.web3d.org) is a descriptive language for the creation of virtual worlds, which can be viewed with special VRML browsers and also standard Web browsers. VRML allows the creation of scenes out of hierarchy of nodes build out of primitive objects, properties, and transformations.
- Active Worlds by the Activeworlds Corporation (http://www.activeworlds.com) is a software tool especially designed for the creation of virtual worlds that can be shared by different people.

There is a great number of research project dealing with the representation of library services and document collections in a virtual library. There are approaches with very sophisticated means for document representations, but also approaches using real-world metaphors. Within the size of this paper, we can only mention three approaches.

CAVE-EDT at Virginia Tech is a 3D virtual world modeling a (fictive) library, based on VRML [4,5]. The user can navigate among several rooms which contain bookshelves for different subjects. User interaction is based on a special wand in the hand of the user, which can be used for both navigation and browsing collections of theses and dissertations. It is possible to receive title information

of selected books as well as an abstract. The concern of the project was not to have a full-working library interface but a test bed for studies of the user behavior.

LibViewer at Vienna University of Technology [6,7] uses real-world metaphors for the representation of documents in bookshelves in order to assist the library user in browsing large collections. Not only location, size, color, label are considered, but also properties like the material and the condition of the book cove, or the existence of dust. LibViewer can be used by a Java Applet.

CNAM (Conservatoire National des Arts & Métiers) in Paris is working in the visualization of rare book collections [2,3]. A very interesting idea in this research project is not to use metaphors for the representatives of the underlying collection in the virtual bookshelves but textures showing digital images of the books. This way the user can visit the books exactly the same way he/she would in a real library. The interface is realized with VRML.

Finally, we want to mention the project PSDoom at the University of New Mexico [1]. This project is not a library project, but it is very interesting for us, because here a 3D action game (Doom by id software) has been used as the basis for an interface for operating system administration. In PSDoom processes on a Unix computer system are displayed as monsters. The user can survey the running processing and can wound processes in order to decrease priority or even kill processes by shooting on the monsters.

CONCLUSION

In this paper we presented an approach to close the gap between computer games and 'serious' applications like a graphical user interface for library services. We created a virtual world of the university library in Karlsruhe, using the game engine of the 3D action game Quake II.

The resulting prototype surprises with very impressive graphical capacities, it allows a very fluent movement through the virtual world, and it is very easy to use. Very important, of course, there is a fun factor in the exploration of the various possibilities the user can navigate and act in this virtual library world.

We did not use all possibilities of the selected game engine. We have not exhausted the graphical capacities, so the impression of a real world is limited; and we have not converted all the ideas for library services in our virtual world. Both was not our aim.

One of our aims was to show that the use of a computer game as a basis for serious applications and in the special regard for the design of visual interfaces is possible. We have presented a technical solution for the adaptation of one game. We invite research groups from all over the world to develop applications on their own.

Our second aim was to investigate the acceptance of different, innovative library interfaces. The particular question here was whether a game interface is really attractive. Preliminary results confirm this assumption, but for a definite, verified result we need more investigations.

Meanwhile, id software has decided to disclose the entire source code of Quake II, in order to give other parties the chance to develop action games on their own. This gives the chance of a new version of the library interface where some limitations and restrictions could be removed. Another idea is to rewrite the interface for the improved game engine that id software has introduced with Quake III. This game engine will support 24 bit colors and curved surfaces. However, it will also have higher demands on hardware, so it is not sure whether it will run on the library computers.

We do not want to conclude this paper without a warning. The content of 3D action games like Quake II is war, similar to chess. But unlike chess, the good graphical possibilities give the player the chance to take part on the action deeply affecting. Although our library interface is harmless, it is possible to use the same game engine with maps found in the Internet which may have an unexpected influence on some few people. However, another fact is also true: playing games is fun. And what is wrong when people have fun while walking through a library or browsing in digital collections?

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