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Multimedia Information System in 3D Space (MISS)

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http://sgi.felk.cvut.cz/MISS/rufis.html

Abstract

***M**ultimedia **I**nformation **S**ystem in 3D **S**pace (MISS) is a case study project for development and testing of information system using both HTML and VRML paradigms. Buildings, offices and other parts of a real world are modeled by VRML and finally presented via WWW. Realistic look of virtual space helps to gain information in a natural way. A pilot version of MISS has been developed for Department of Computer Science and Engineering at Czech Technical University in Prague. The aim is to allow virtual walk through the Department and to gain basic information about its structure and people.*

1. Introduction

The MISS information system should give as much as possible information about Department of Computer Science and Engineering. The Department is located in the historical center of Prague. It is placed into a complex of several buildings belonging to the Czech Technical University. One of the purposes of the MISS is to help visitors to get orientation in the complex area of university buildings. Next aim is to give information about offices, laboratories, staff and research activities. It is not easy to achieve both targets described above by a simple way. That is the reason why MISS system consists of several parts. Some of them have two dimensional character, whereas others are fully three dimensional. The MISS system is currently in experimental stage and serves as a tool for finding the best way for helping foreign visitors to get orientation and rich information about Department of Computer Science and Engineering.

The paper gives overview on techniques used for implementation of MISS system [1]. Basic paradigms for development of multimedia information system are discussed in the chapter 2. Detailed explanation of selected approaches is presented in chapter 3. Implementation details are described in chapter 4. The last chapter describes our experience as well as several directions for future work.

2. Construction tools

The main access to MISS is ensured by WWW technology, one of the most popular phenomena during last few years. World Wide Web offers rich and easy access to information. It is closely connected with HTML, the language for description of hyperlinked documents. Formerly textual oriented, HTML pages started to be widely used for combination of text, images, movies, and sounds. New versions of HTML (ver.3.2) offer possibilities for arrangement these media into tables or frames, but all information sources are expected to be planar only.

New method for describing spatial information has been designed by authors of VRML - Virtual Reality Modeling Language [2]. The language is primary oriented to models of three-dimensional scenes extended by multimedia information. Textual information plays minimal role here.

The main advantages (marked as "+") and disadvantages (marked as "-") of both mentioned languages are briefly listed in the following sections.

2.1 HTML

Almost 80% of all Web pages in the WWW is currently constructed using HTML commands only. Others are combined with CGI scripts, Java or JavaScript parts. HTML represents the main stream in the Web. The language is simple, but powerful enough for many applications. Advantages of HTML are clear:

+ standard accepted by any browsers, on all platforms
+ hyperlinked combination of text, still and moving images, and sound
+ number of editors and file converters available

Of course, HTML is not the best solution for all interactive and multimedia applications. Here are some gaps, that must be filled by another approaches:

- limitation to 2D space only
- language is static, without possibility of user's (author's) extensions
- actions (hyperlinks) change only one object (page, frame, image) in time

2.2 VRML

VRML is independent of HTML. It is a language for description of highly interactive three dimensional scenes. Current version 2.0 is called "Moving Worlds" and provides support for easy walk-through virtual scenes, multimedia effects and real-time interaction. Hyperlinks are used either for retrieving and combining parts from another Web sites or for "hyperjump" from one virtual word to another one. The positive features of VRML are:

+ introducing three-dimensional worlds in natural way
+ platform independence
+ working well over low-bandwidth connections
+ supporting an extensible model

Since rendering of 3D information requires still high computation power, not all Web browsers support VRML in the last version. VRML thus brings also certain problems:

- slow rendering, even if scenes are not huge and complex
- no possibility to show HTML pages inside virtual worlds
- lack of authoring tools

2.3 Combination of HTML and VRML

Both languages serves for different classes of problems. Simply said, HTML is for 2D applications, VRML for 3D ones. The common base for both is in use of hyperlinks and multimedia. Certain combination of HTML and VRML should overcome limitations of both and to enable design of flexible and powerful system.

Commonly used Web browsers (Netscape, MS Internet Explorer) represent good starting points for efficient combination of these two languages. Although browsers have been developed for presentation of HTML pages only, a plug-in technology allows to incorporate VRML files into the same environment. Virtual worlds can be activated from HTML pages. Similarly VRML files can contain hyperlinks to HTML pages. Limited number of VRML scenes can be included directly into HTML page. The best way is to put VRML file in one frame. Netscape Navigator allows also the second approach - to incorporate VRML scenes into text using special non-standardized command <EMBED>.

2.4 Java and JavaScript

These modern languages can be viewed as another layer upon HTML and VRML. Relatively static behavior of HTML pages and simple animation performed by VRML objects can be improved by external programs written in Java or JavaScript. Although we still do not use these language extensively, we expect their bigger impact in the future.

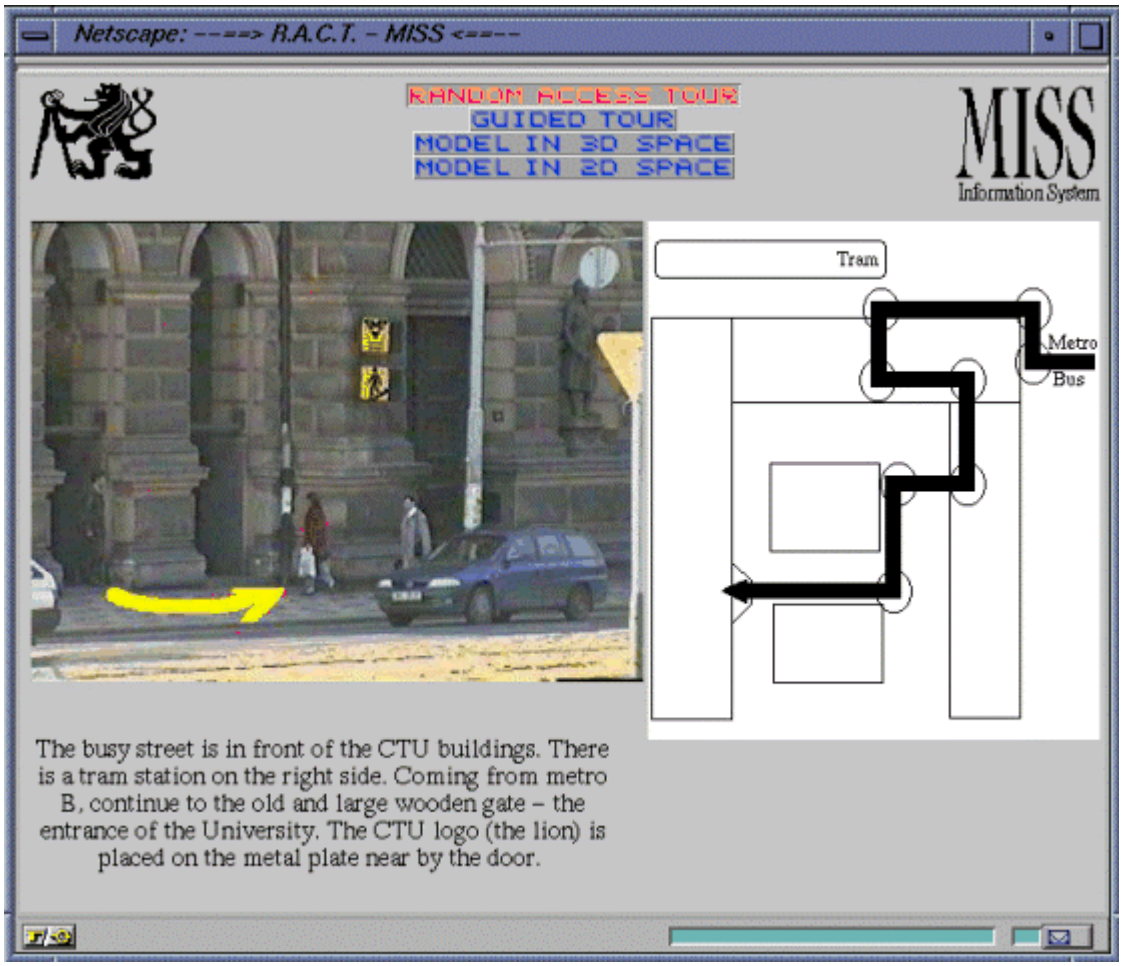

Fig.1: All pages of MISS information system are subdivided into frames

3. Designing MISS

The aims of the system described above are quite wide and cannot be achieved by simple solution. Some information are of two-dimensional character, while others are spatial. The system is thus subdivided into several parts, each of them has its special purpose. Some parts are hyperlinked together, some are autonomous.

A 'Welcome Page' is written both in English and Czech. A user continues to other information pages after selecting the language. All other pages have got similar look. They are constructed using frames as seen in Fig.1. A user can switch among parts using main menu at the top. The following parts are currently available:

- Random Access Tour
- Guided Tour
- 3D Model of the Department (Building-E)
- 2D layout of the Department

The first two parts help a user to get into the Department of Computer Science and Engineering from outside, while the others represent a combination of 3D and 2D information which is presented in multimedia form.

3.1 Random Access Tour

A user can virtually go through complex of Czech Technical University buildings here. A sensitive map shows the way from Karlovo nam. (Charles square) to the Department of Computer Science and Engineering. The tour starts in the exit of Prague Metro, which is commonly known point. Photo images in the left part of the window show a real look of buildings, exteriors, and interiors. Images are completed by informative text. Important places are highlighted on the sensitive map (Fig.1, right). A user can select any place of interest by activating sensitive map. This part of MISS is completely two-dimensional.

3.2 Guided Tour

This part is a variation of the previous part. Instead of random access of photo images, a user is guided step by step from the start point to the last point - building "E", where the Department is located. The tour is driven by activating two arrows only - forward and backward.

While the first part seems to be the "official map" for visitors, this Guided Tour is fully experimental and is open for further students work. We are going to test several approaches to improve information value of the tour. Students are preparing the following extensions:

- images presented as an automatic slide show
- full movie instead of set of images
- combination of photos and graphical symbols painted on important places like crossing points, information desks, etc.
- voice information binded with each image describing its content.

The last extension is closely connected with the research project "User interfaces for blind people", which is currently studied and implemented in the Department.

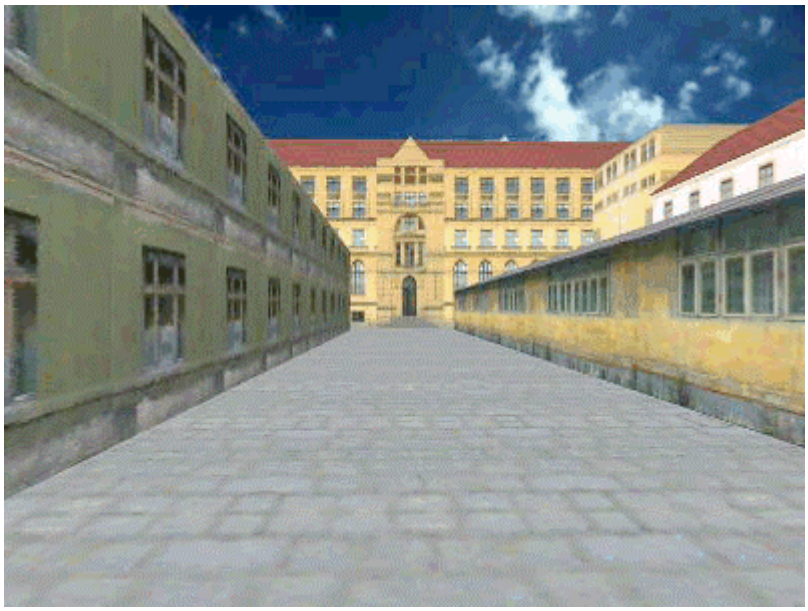

Fig. 2: Model of the departmental building "E" in VRML

3.3 Spatial Model of the Department (Building "E")

This part is fully three-dimensional and contains the model of the building "E", where the Department is located (Fig.2). Not all, but many of offices, corridors, laboratories and other parts of the building "E" are presented via VRML. Since the model of the whole building contains lot of data, the building is subdivided into sections. A user walks through one small section only and "jumps" into another one by activating doors, stairs, etc. Navigation paths are prepared for smooth walking among predefined viewpoints.

Virtual offices are full of multimedia information objects (Fig.3). When a user enters into an office of some person, set of both personal and official information is available after activating objects in that room: there is a photo portrait hanging on the wall. When activated, a welcome speech can be listened. A user can get a list of published articles available in HTML form in other window (activating a bookshelf), look at office hours and make a reservation for a consultation (clicking on an arm-chair), try to establish a "computer talk" (activating a phone), send an e-mail (selecting a computer), etc.

This part of MISS has been combined from several student's works and more three-dimensional objects from other semestral works are continuously prepared.

Fig. 3: An office with 3D multimedia information objects

3.4 Flat Layout of the Department

Not all visitors use 3D browsers. This part of MISS system is designed especially for users which have no possibility to render 3D scenes. The building "E" is subdivided into three separate maps - one for each floor. These maps are sensitive and a user can get similar information as in the case of the 3D browsing. HTML pages contain links to 3D models of offices and switching to 3D virtual space is possible and easy.

4. Implementation details

First and second part of MISS contain set of photo images taken by video-8 camera. All images have been processed with the aim to improve contrast, intensity, and brightness. We did not meet any troubles with this kind of work.

Creation of VRML scenes represent a lot of effort. The 3D model of building "E" has been created in the time, when no authoring tool were available. The overall model has been constructed by AutoCAD and later converted from DXF file format to VRML. The main problem of such approach is the need of postprocessing. All colors and textures have to be set, links between subparts have to be carefully added. Although using named "blocks" in original model helps to understand and manipulate with VRML files, we really do not reccommend this technique. Automatically converted files are not well structured and the main disadvantage is inefficient conversion of polygons with holes (e.g. windows, doors). Such polygons are triangulated to large number of very thin triangles. Rendering is slow and sometimes not correct. We are going to change the 3D representation using native VRML editor.

5. Conclusion

A pilot version of multimedia information system using 3D scenes has been presented. The project has been started last year and it is based on the semestral work of students. The system is open for further improvements and serves as an experimental frame for various approaches, including 2D maps, photo images, movies, 3D scenes and interactive objects, sounds, etc.

Currently, users prefer 2D information layout, which represents "classical" approach. Common acceptance of 3D multimedia information fails, because of lack of efficient 3D browsers. We believe that the situation will changed in the near future when hardware accelarators for 3D rendering will become widely available, especially on PC platform. The importance if spatial information will grow and the VRML scenes will bring better and more useful way for retrieving many kinds of information.

Similar approaches can be found at several places in the Web. Texas University campus [3] has been modelled in VRML to allow virtual tour through it. Three dimensional buildings have been created with high precision in AutoCAD and converted to VRML. Virtual space does not contain any multimedia objects, but links to HTML pages only. A user can also get few movies with tours around most interesting places.

Next place with 3D models of buildings is in the Center for the Digital Arts, UCLA's School of the Arts & Architecture [4]. VRML worlds are again used for architectural look only, without other information content.

References

[1] http://sgi.felk.cvut.cz/MISS

[2] http://vrml.sgi.com

[3] http://bush.cs.tamu.edu/~b0x9330/tour

[4] http://www.cda.ucla.edu/caad/w3ducla/uclawrl/main.html

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