Interactive Streamed Media in Virtual Environment

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ABSTRACT

In our work, we are dealing with problem of displaying video content under given restrictions. This work is oriented on museums and galleries and their exhibitions. The content has to be secured so it cannot be downloaded. With technology of streaming we offer solution for museums and galleries to display their exhibitions in videos. The transferred data is protected by an encryption in order to reduce the possibility of data leakage. The second challenge is to enrich the video with non-standard interaction elements, to make the exhibition more user-friendly and more interactive. Therefore, we propose using the component called "virtual path" for better orientation in museum. This component also visualizes the process of playing the video. Visitors get the opportunity of moving around the museum in chosen order or skipping corridors, which they do not intent to visit. To do that, we suggest adding some additional information about the scene, which will be displayed on demand.

Keywords

Streaming, virtual museum, interactive video, extended interaction

1. INTRODUCTION

In these days more and more museums and also other companies use Web for presenting exhibitions or work. Their presentation consists of certain text, images and also some multimedia elements such as video or audio. First, we have to consider all the possibilities for presentation of the museum.

The simplest way to do this is using a photo gallery like in [EUROPE]. Panoramatic photo is more advanced way to present the exhibitions used in [LOUVRE]. However, using pictures has some disadvantages, they are static and they have small

angles of view. On the other hand, the advantage of using photo galleries or panoramas is that they do not take up a lot of space and bandwidth. On the other hand, we can create 3D models of objects and create a virtual walkthrough. This type of presentation is interactive, but it takes a lot of time to make model that will be realistic. 3D models as a presentation of museum is used in [Fer07a].

The last, but not least way of presenting a museum or gallery is to play a video tour around the exhibition. This type of presentation, which was for the first time used in [Cla78a], is very dynamic and video have an audio. Although the visitor can control the walkthrough and jump from one position in video file to another, s/he is not as free as in virtual 3D space.

Our goal is to propose a solution for video in virtual environment, using streaming technology for data transfer and encryption to make the content safe. In addition, we have to extend the standard interaction elements and propose additional interaction.
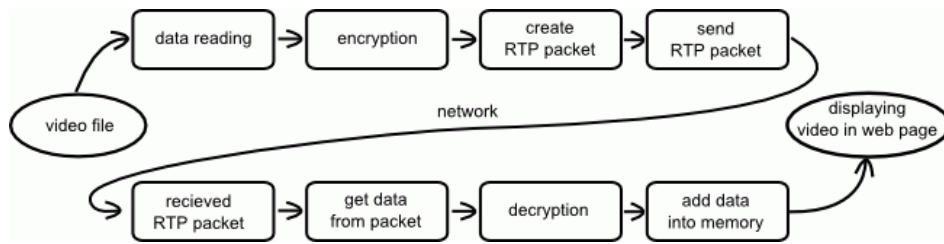
Figure 1: Pipeline from video file to displaying video in web page.

2. BACKGROUND AND RELATED WORK

In this section, we will discuss different ways of displaying a video in web page as well as how to transfer the video data from server to client.

HTML in its last version does not have a tag for adding video into web page. Yet, HTML has tag *<object>* or *<embed>* to embed external video players like Windows Media Player [W3c99a]. Very popular among other web oriented technologies is Flash [FLASH]. The last way is to embed application written in a programming language, e.g. Java.

When we are considering using video file, we have to decide file format (avi, mpg or mov), video format (mpeg-2, mpeg-4 ...) and coding algorithm (DivX, Xvid ...). We will stream the mov file format, as video format we used MPEG-4 specification and the new coding algorithms H.264 [Wie03a].

The video data are saved on server and we have to transfer it for the visitor. Our goal is to forbid downloading the video file, therefore we can stream the data and the user can just see the video and cannot download it. More about video streaming may be found in [Mac02a].

There are many papers that consider streaming technology, so we will mention just a two of them. In [Xu04a], authors propose solution to problem with packet or frame lost while they streamed MPEG-4 video file. The solution to problem of limited storage for video file in one server may be found in [Shi06a].

3. STREAMED MEDIA IN VIRTUAL ENVIRONMENT

In this section we offer our solution for playing streamed media in web page. We will present application named StreamBoat.

3.1. Streaming Data

The first important part is the data transfer. *Figure 1* displays the whole pipeline for transferring data from video file to displayed video. We use *on demand* video streaming [Mac02a], because we have the data already in a file. StreamBoat is a client-server application, where server is responsible for reading data from file and sending the content to the client. Visitor is interacting with client part of application which is a Java Applet. The applet is responsible for playing video, gathering received data and control the server side.

For streaming protocol, we implemented a part of RTP [RTP] for data transfer and RTSP [RTSP] to control the streaming process.

3.2. Data Safety

One of the conditions of this work is to make the content of museum safe from downloading. One of the security measures is streaming technology which erases used data. Although the streaming technology and the RAM memory should secure the content, someone might capture the packets and restore the whole video file. Therefore, we include encryption algorithm into data transfer. The encryption algorithm that we implement is a simple one, but it can be replaced with another algorithm.

3.3. Video in Web Page

To show a video in web page we choose to display the content in Java applet. The package Quick-time Java is controlling and displaying the video content [QTJDOC]. As a consequence, we control the displaying part and data transfer separately. The advantage of this approach is that we can receive the data faster than video plays. However, some data are needed on the client's side before the video starts.

4. INTERACTION

In this section, we will propose and introduce two elements for better interaction. Basically there are three common interaction elements in standard video players, buttons: PLAY, PAUSE, STOP etc., time line to make a linear jump and slider to control the volume. We suggest adding two more elements as virtual path (4.1) and extended interaction (4.2).
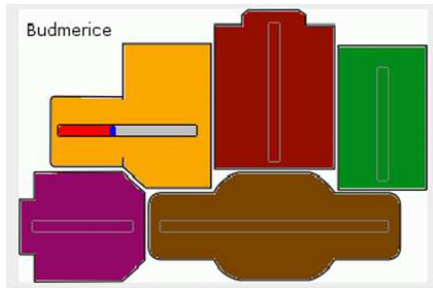
4.1. Virtual Path

Figure 2: Interactive element called virtual path with ground plan as a background.

As I mentioned before, *Virtual path (figure 2)* is an element for better orientation in the museum and it gives free option in creating visitors own tour. The visitor in the real museum has information about the museum area, like number of rooms or the connections within rooms. We propose to use the ground plan to add this information about the museum as a background of interactive element.

The main concept is to divide the ground plan to rooms or smaller segments like hallways. For every segment there needs to be a separate video file about the corresponding segment. Instead of one timeline we will put separate timelines for every segment into
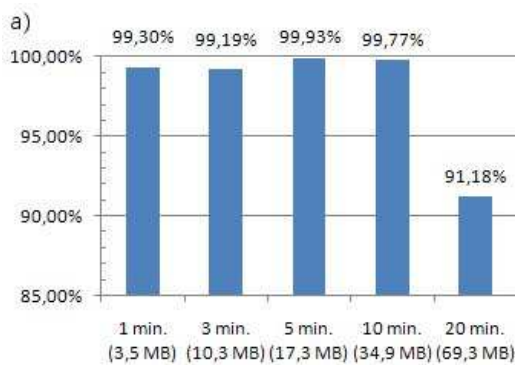
a corresponding room. These timelines are "connected" with each other in certain places and visitor may choose how s/he will continue the tour. They may be also rotated in every angle. This brings up a *non-linear* walkthrough where the visitor has more choices of direction in the exhibition.

4.2. Additional Information and Extended Interaction

Beside the *virtual path*, we suggest to add some additional information about the objects in video. In work [Son08a] authors propose to add more information about a picture, and they hide it inside the image. We suggest storing the additional information in extra files or database and they will be shown only on visitor's demand. For this purpose we need an interaction element that will represent them.

Figure 3: In the video part there are red dots. These dots represent more information about objects.

Let's imagine an object in our video and we know more information about it. We get the position of the object and also the curve of how it moves. In our solution we have a quadratic B-spline which describes the movement in time. In the actual position of the object we put a dot, clickable object, which will represent some additional data (*figure 3*).

Figure 4a: the data transfer quality test. We streamed 5 videos and we compute the ratio of received data and sent data.
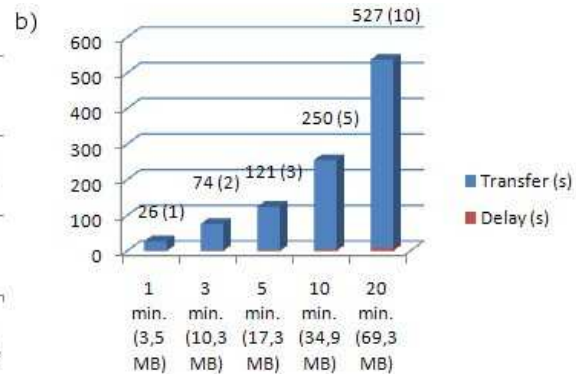**Figure 4b: the blue part - time needed to transfer whole video, the red part - delay before start playing**

If the visitor clicks on the dot, s/he will get the additional data. In our solution we have to store just control points of the curve and the start time and end time.

5. RESULTS AND FUTURE WORK

The last part of our work was to make several tests; tests of the quality of data transfer (the criteria were the ratio of sent packages and received packages) and speed test (we have measured the speed of data transfer and the beginning delay). We also had an anonymous inquiry. The server connection for tests was 1,5Mbps down /512Kbps up.

The results of the first specialized test on the quality of data transfer (based on the size of video files) are displayed in *figure 4a*. From the same figure you can see that in all cases the quality was better than 91%. We consider these results as a success. You can find the results of the second test in *figure 4b*.

In the inquiry there were about 30 respondents and mostly (about 65%) they think the application is useful and also like new elements for interaction.

For future work we have some thoughts about another interaction.

6. CONCLUSION

In my work we have connected the art with the technology and proposed the solution for the video in web page problem concerning streaming technology and data encryption for virtual museums and galleries. Our application gives the opportunity to explore the museums from the comfort of your own home and see the exhibition. We extended the standard interactions element with two non-standard. The virtual path gives non-linear movement around the museum and we added additional data to some objects on demand.

7. ACKNOWLEDGMENT

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