Documentation and Internet Presentation of Cultural Heritage Using Panoramic Image Technology

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Abstract

Panoramic image technology provides new facilities for the presentation of cultural heritage recordings. Image based visual reality is an approach for documentation of monuments and sculptures avoiding the time consuming modeling process needed for a geometric model. The technology is not limited to existing objects, it can be used for virtual reality models as well. Plug-ins for Web browsers like Apples QuickTime or the LivePicture Viewer provide unlimited interactive access.

Single images taken from a fixed position while rotating the camera have to be stitched together. Warping onto a cylinder surface or sphere surface results in the spatial imagination the user gets while navigating through the model at the comupter screen. A photo object is created by moving the camera around the object with a fixed target point. Those objects can be turned around by dragging the mouse. Authoring tools are available for the description of complete scenes. Those scenes can be interactively entered by visitors.

1.   Methods and Cameras for Producing Panoramas

There are five basic techniques for producing panoramas. The **conventional** method crops the image to a long format.When the negative is printed it looks like a long narrow panorama but the field of view is still unchanged. The APS cameras today provide such an imagination.

A series of images taken with a rotating exposure direction and displaying the photos next to another is the oldest method to show a wide field of view. The advantage of digital image technology makes the **segmented** method very popular today. Taking the photos with a digital camera enables an automated process to display scenes for interactive viewing.

Field of views up to 180 degree can be photographed with a s**wing-lens** camera. The lens is mounted in a rotating cylinder while the film plane is curved. During exposure the lens rotates and paints the image through a slit onto the film. A camera of this type is the Noblex manufactured in Germany, see figure 1.
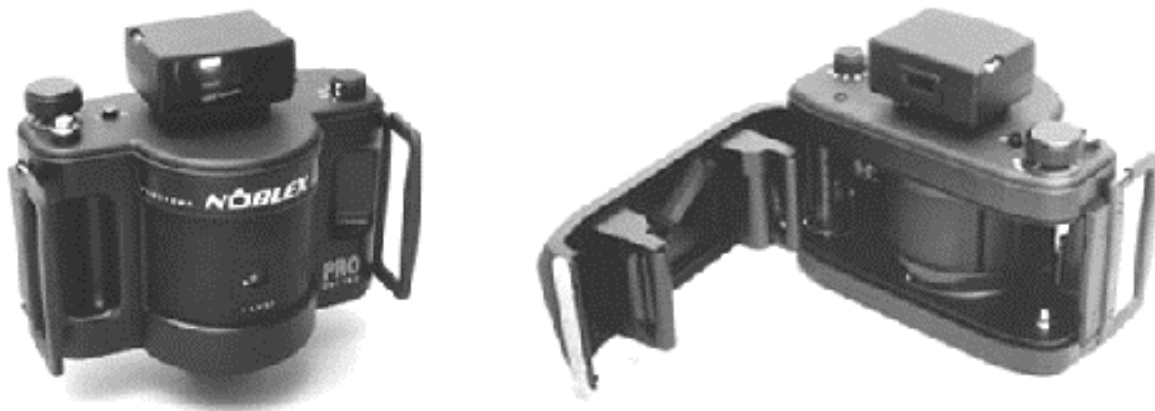

Figure 1: Noblex swing-lens camera manufactured in Germany

The **rotational** method needs a camera which can rotate about 360 degree while the film turns synchronously opposite to the camera rotation. This technique is still very popular. An advantage is, that moving objects can be recorded without any problems. While taking street scenes with the segmented method, people or cars can occur several times in different positions. The Roundshot camera from Switzerland is state of the art of rotating cameras, see figure 2.

Figure 2: Roundshot rotating camera from Switzerland

The Noblex and the Roundshot cameras are both using 220 film. It has to be mentioned that the use of those expensive panoramic film cameras needs special film scanners for digitizing. A much cheaper solution is the use of a digital camera with segmented image order.

Especially suited for the needs of media profession and Internet presentation the PanoCAM DPC-10 from Spheron VR is designed to capture 360 degrees shots of it´s surrounding by rotating the camera . The image is captured by a CCD , giving a digital panorama without intermediate procedures like stitching. The camera is computer controlled . With the PanoCam Server software panoramas can be taken in predefined intervals and stored on a Web server, from where they are distributed. Maximum resolution of a 360 degree shot is 1350x9000 pixel.

2. Segmented Panorama Photography

The most precise panorama consists of evenly-spaced photos using a tripod. A special panoramic head asures that the camera rotates on a level plane around the center of the lens. The overlapping area should be 20% -50 %. Using the portrait format increases the number of photos but extends the vertical field of view. The number of photos depends on the focal length of the lens, the film format and the distance to the object. A number of 12 photos using a wide angle lens of 35 mm in portrait format can be sufficient for outdoor scenes. All shots should be taken with autoexposure off. Avoid shooting into the sun. Best conditions are given when it´s cloudy and bright at mid-day.

Figure 4: Principle of the segmented method for taking panoramic images

The camera is mounted on a panoramic head correctly if there is no parallax to detect.The setting can be controlled if a close object with a faraway object aligns while rotating the camera from side to side. There should be no relative movement between the two objects. Otherwise the camera has to be adjusted in order to elimate this movement. Figure 5 shows the principle of a panoramic tripod head and a solution supplied by kaidan.
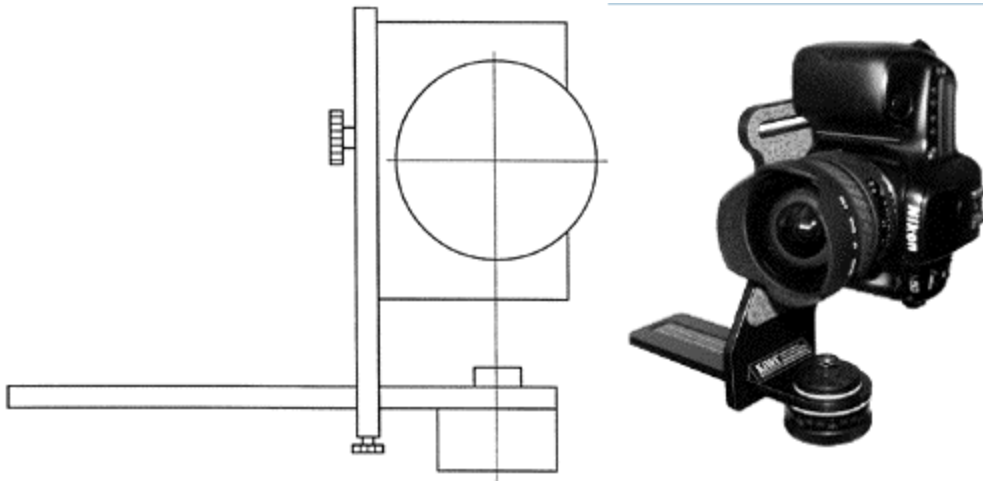
Figure 5: Principle of a panoramic tripod head and a solution from Kaidan

The above described procedure for taking panoramas can be performed in the same way in the virtual world of a CAD system. Define a camera point and a target point on a separate camera layer in your drawing editor, copy the line in a circular order and transfer the data to the camera specification. Switch the camera layer off and begin rendering a sequence of images. The direction of sunlight can be moved with the viewing direction. The example presented in chapter 4 is a reconstruction of an ancient castle with estimated construction state around 1500 is done with AutoCAD using AccuRender for rendering. The single images are stitched together with PhotoVista.

3. Panoramic Stitching Software

Numerous software packages for stitching panoramas from single images are available. Some vendors of digital cameras provide a software free with the camera. Apple´s QVTR Authoring Studio for the Macintosh or , PictureWork´s Spin Panorama and PhotoVista from LivePicture for the PC are known products. The output of the programs are QTVR movies , JPEG-Files or images in the hierarchical Flashpix format. With PhotoVista a second IVR file, a text file in VRML 2.0 format, is stored for displaying the panorama with a special viewer. IVR is acronym for Imaged-based Virtual Reality. Another interesting variant is VideoBrush Panorama that captures video sequences and converts them into panoramas.

Functions of a stitching software are registration, blending and warping the panorama to a cube, sphere or cylinder. Registration is the process of finding the exact place of overlapping images in a panorama.Taking the information from two overlapping images and combining them together into one seamless image is named blending. Automatic registration and blending can be disabled as well as warping to curved surfaces. This is necessary if photos from a swing-lens camera should be mounted to a 360 degree view.

A hotspot is an area in the panorama where a link to another object can be defined. Due to hotspots a walk around in a scene consisting of several panoramas is possible. Usually hotspots must be defined relative to the image size. Authoring tools are available for writing complete scene descriptions.

4. Web Publishing of Panoramas

Panoramic images are 360 degree views of a scene from a particular viewpoint. Interactiv viewing of a panorama is provided by panning and rotating. Panoramas can be linked together by clicking the hotspots. Panoramas are suited for a client-server environment . The client only executes the viewing program, while the server transfers the data upon request. VRML is the description for 3D objects on the web, therefore a panorama is described as a new node type in VRML. For displaying VRML models a browser needs a plug-in. Here we focus on the LivePicture Viewer which is available as a plug-in Version or a Java version. While stitching panoramas together with Photovista, the final result is stored as JPG or FPX image and a second file type IVR is generated as well. This second file is a description according to VRML how to display the image file.

The description of complex 3D scenes can be done by editing the IVR file. Since this is a time consuming job, use of an authoring tool is highly recommended.. An alternative solution is the use of a Java applet. In this case the client does not have to install the viewer but the resolution for a JPEG panorama is limited to 50000

pixel. While using the hierarchical Flashpix format a smaller size of the viewer window increases download speed, the resolution is not limited in this case. The image server software must be running on the server to enable support of FPX file formats.
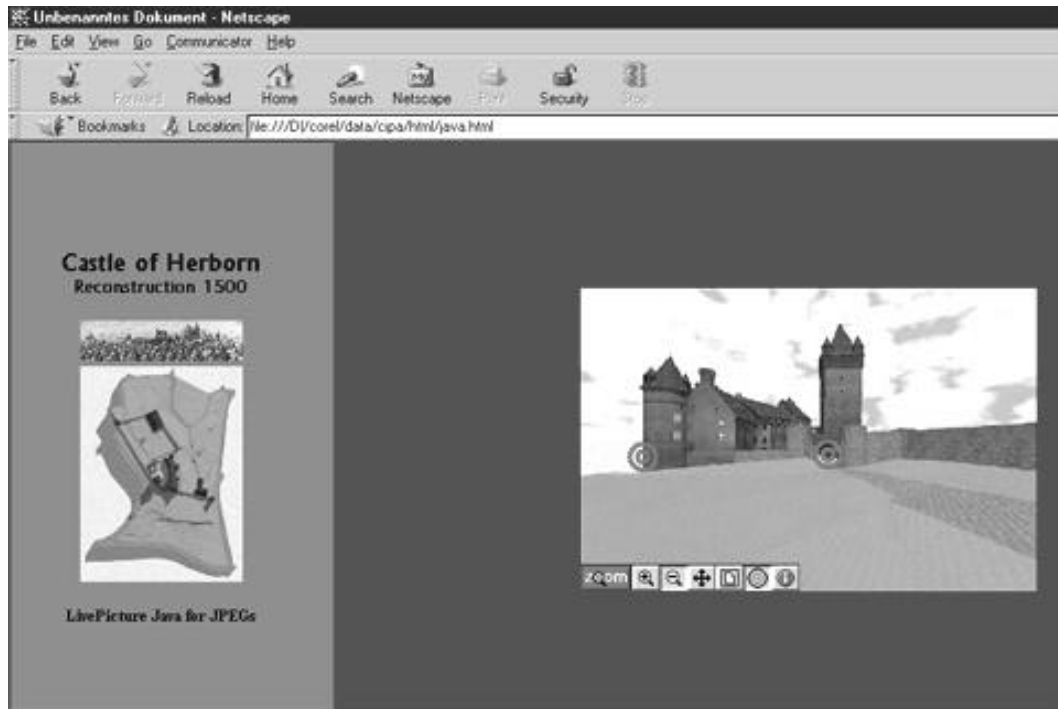

Figure 6 : Screenshot of a JAVA example, displaying a virtual model as several panoramas

Figure 6 displays a screenshot of a presentation showing the reconstruction of an ancient castle back to 1500. On the left frame is an image map including hyperlinks to the panoramas in the right frame. Any panorama has ist own hotspots so that the user is able to swicht from panorama to panorama. The following HTML code provides information about embedding the JAVA code
and parameter settings. The hotspot definition are the values of upper left and lower right corner divided by the image extension.The coordinates of the hotspot areas can be measured with a screen ruler or by using image editing software. For more detailed information about scene descriptions follow the URLs given here in the references.

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width=360 height=240>');
   }
  else
   {
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code="LPPano.class" width=360 height=240>');
   }
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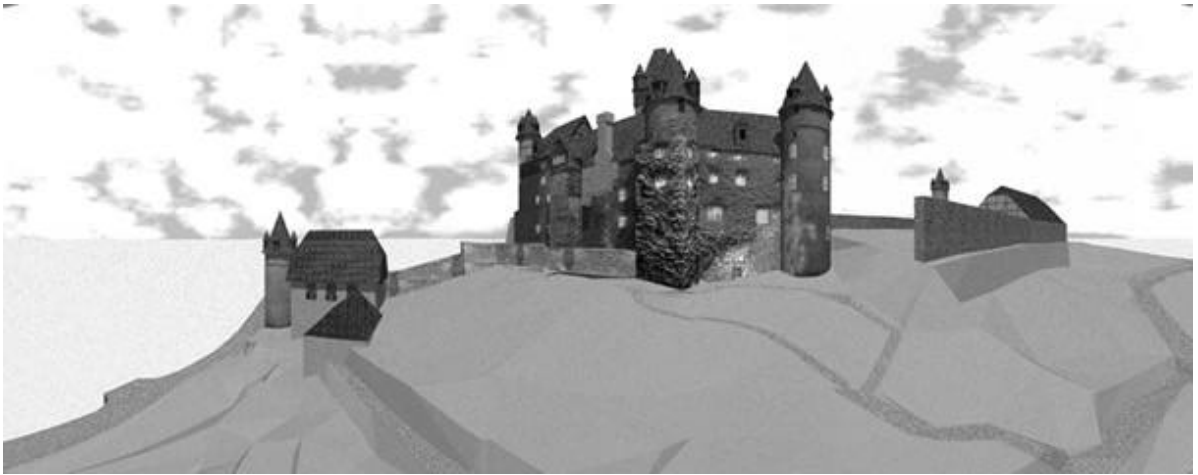

Figure 7: Panorama of a virtual model, displayed as store in JPG format, rendered for a cylinder presentation.

A second example is given as a panorama from visual reality. It is an indoor scene of a Russian Cathedral including sound.

Figure 8: Panorama of visual reality, inside a Russian Cathedral

Another interesting application is the combination of visual reality, existing environment recorded with photos, and virtual reality, non existing projected building. The example of figure 9 display a projected sport arena in its environment. This work is a diploma thesis from the Department of architecture and Civil Engineering of the Bielefeld University of Applied Sciences. Kindly supplied by Ralf Burkhardt, who made the design and panorama.

Figure 9: Combination of of a projected sports arena and the existing environment as a panorama.

Conclusion

Panoramic images are very powerful containers of information. This paper presented virtual and visual models and a combination of both for Internet publication. From the point of view of the photogrammetric application, panoramic images are useful for measurements and dimensional analysis as well, using methods known from multi image photogrammetry Taking into consideration a well adjusted setup of the camera and calibration. Image refinement before stitching enables precise measurement form two or more digital images warped onto a cylinder or sphere with the benefit of a large object stored on few images only. All examples from this paper can be viewed by visiting http://www.imagefact.com .

References

[1]   All given examples can be viewed visiting www.imagefact.com , look here on the English pages in the left navigation frame under PANORAMAS. The examples can be displayed by clicking the icons. Please accept some loading time and install the plug-in if necessary.

[2]   www.shortcourses.com , very interesting page about digital photography,
stereo images and panoramic technology.

[3]   http://panoramic.net, all you need to know about panorama photography.

[4]   www.livepicture.com , a must for people interested in panoramas on Windows platforms.

[5]   www.multimedia.com.mx, information for developers.

[6]   www.baeumner.de, visiting Frank´s Web site is worthwhile. He hosts at his 3D-club serveral examples of stereo and panorama images using various displaying techniques.