Visualisation of Buildings using VRML - An Example

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ABSTRACT

This article presents an example, which shows how the visualisation of a hospital site for internet presentation was produced. It contains the outside of the whole complex and inner sights of one building with the opportunity of free movement and the presenting of alphanumeric information.

The paper discusses the way of collecting the data by measurement, using analogue and digital plans as well as digital pictures. It shows how these heterogeneous data are combined with a 3D CAD-Model and transformed to an homogeneous internet visualisation via VRML.

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1. MOTIVATION

The internet has become to quite normal medium for spreading information. So for surveyors it also should be an appropriate method for presenting themselves and their works to a wide public. Additionally projects in their structure can be presented. More than this, the results of the surveying works themselves could be shown, as part of contracts.

Normally the techniques are used to publsh text documents or simple graphics like maps or pictures. The increase of the speed, in which the data is transported, makes it possible to transport animations like films as well as the result of spatial requests to GIS.

Virtual reality is a development primary made for videogames. But today it is also used for presenting special projected objects in a given local situation. With this the decision of realisation has a better base.

Surveying is subject to detecting and documenting geometric situations in plans and digits. For representing the results of surveying additionally visualisation the objects with the target to deliver the base of decisions gives new aspects to the profession of a surveying engineer. An example will show the chances.

Fig 1: Overview of the Object

2. OBJECT OF THE GIVEN EXAMPLE

Fig. 1 gives an overview of the given object.

Object of the works is the hospital “Hohe Warte” in Bayreuth, Bavaria. It is in the possession of the state of Bavaria. It lies at the edge of Bayreuth and towers the total area of the town. It was built in the years 1938 to 1942. It has undergone different medical orientations. Since 1975 it has been used as a general hospital. In 1993 it was decided to erect an additional building to fulfil future tasks. The commissioning took place in December 1999 / January 2000. The total costs amounted ca. 32 million €. The utilizable space is set as 2,693 sq meters.

The object consists essentially of four parts. Three of them, the administration building, the main building and the new building are subjects of the presented visualisation.

3. TARGET OF ACTION

The result of the work is supposed to be a visualisation of the object including an exemplary information system. The owner of the hospital could use this for presentation as a medium for maintaining the image and properly as a aid for orientation. For this the chosen parts of the object are to be presented as an exterior view and the mentioned entrance hall as an interior view as well. The visualisation has to show the correct relative dimensions and has to be detailed in a manner that all elements of interest can be presented. The internet performance should be used by future patients and other interested people.’

4. COURSE OF ACTION

The result of the visualisation is a final product of a lot of single steps, which will be discussed in detail further on.

4.1 Utilize and Adding Available Information

Basis for the graphical construction were ground plans given in the DXF-format. Those data were created by measurements, taking place during the planning stage of the new building Additionally analogues plans were used for replenishing or simplifying the construction of the view of the interior sight and digital plain.

The majority of additional data is recorded by further measurements. These define a local coordinate system. Parallel digital pictures were taken for the definition of the later textures. Textures are used for showing the objects real appearance and consist out of pattern or pictures.

Through the measurements a digital terrain model is determined as well as the fitting points for calculating the distortion of the texture pictures. Because of the two given dimensioned analogue and digital data the measurements are used to find the third dimension. These are primary the heights of the rooms and the building. Also the architectural characteristics of the buildings, like oriels etc., can be described through the measurements.

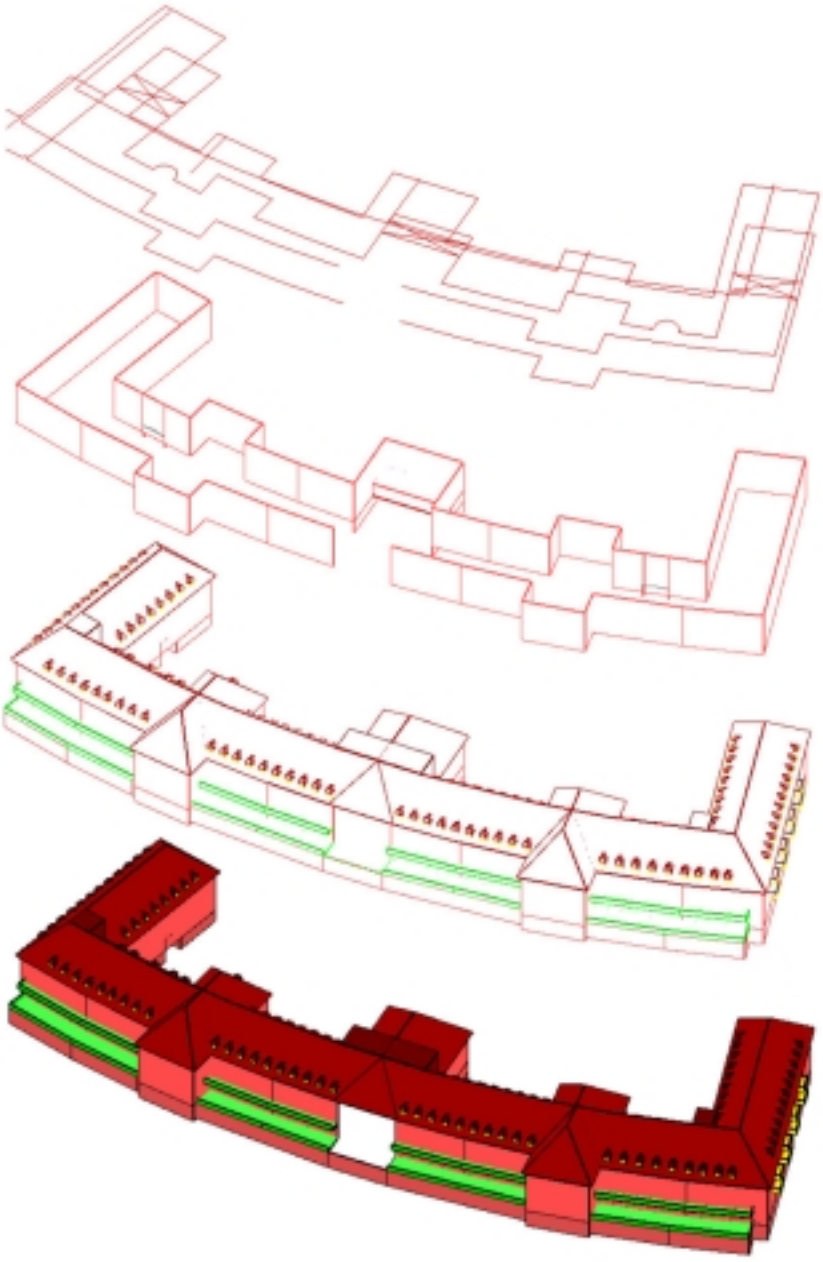

Fig 2: Steps of CAD-Construction

4.2 Constructing via CAD

Fig. 2 shoes the workflow of the CAD-Construction. It starts with the read in and structuring of the DXF-Data and the take over of the results of the measurements. During the CAD-Construction several drawing files were used, which could be combined. These are for:

- The exterior construction
- The digital terrain model
- The interior construction.

In these files the objects are distinguished by the typical CAD-functions of layers and colours.

The data collected during the measurements were put into a conventional CAD-System and processed. Differentiating the information by the structure introduced during the measurements one can develop a three dimensional model of the object. Constructing the model is combining the measurements and the given digital or analogue and scanned plans.
In a first step all outer vertical walls of buildings are constructed by extruding them out of the ground plans with a height measured. Here vector data are used as well as pixel data. They have been reduced to show only the outer shape like the facade balconies, oriels etc. The sizes of wall elements are chosen accordingly to the taken texture pictures.

In a next step the additional elements are added. So the building gets its balconies etc. and a roof as well. In further step the elements are filled with textures. This is an attachment of raster data to the surfaces. This includes a transformation to the geometries. Specially pictures have to have the dimension of the surface before the attachment. This means that the transformation just allows rotations and translations but no distortions are allowed.

The construction of the interior were done on similarly way.

4.3 Textures

Textures give the CAD-elements a realistic look. It shows as favourable to use standard digital cameras for taking the texture pictures. In this example a resolution of 200x200 dpi was sufficient.

The single pictures are distorted because of the current situation of photographing. Software solutions guarantee a transformation onto the CAD-surfaces, which give an orthogonal view. As fitting points the edges of the surfaces or specially measured points can be used.

In Fig 3 the situation shows that a front of one building cannot be covered by one picture. In this case several pictures have be assembled. The required detail has to be cut off. Before the differences in style like colour, contrast or shading have to be eliminated manually. Also Elements like passengers or trees are to be removed, because they are not parts of the surfaces. Finally the treated texture pictures are to be transformed onto the surfaces.

For a realistic visualisation the removed Elements are imported. So the cut off trees have to be positioned in the surrounding. Some formats for raster data like “png” allow to handle some pixel as transparent.

Fig 3: Steps of picture handling

4.4 Export to the VRML-Format and Update of the Source Code

To spread the visualisation to wide public via internet, the data has to be transformed into a format that can be transported very easily. For this the VRML-Format (Virtual Reality Modelling Language) has been used. It is similar in structure to a syntax to the HTML-format, the standard format for internet pages. The so coded sceneries can be visualized by special software, a VRML viewer, which is used as a supplement to a normal internet browser. So the normally two dimensioned information can be added by three dimensional virtual realities.

The primary export is done by interfaced disposable of the CAD-Software. The export includes the vector geometry and textures. It leaves ASCII-coded file for the vector geometry being edible by every text editor and image files for textures. A further handling is necessary for adding special effects to pure objects. For instance those effects are:

– Improving the lighting of the virtual scene
– Additional filling in of points of contemplation
– Filling in of Animations
– Adding of background projections.

The manipulating has to be carried out manually. So different fixed view points can be defined as well as animations prepared. This allows the spectator to move close to reality in virtual scene. He is able to turn around on deliberately, which allows to see objects from all sides.

Additionally to the visualisation hyperlinks can be embedded into the code. These are connected to further elements. If the cursor is posed onto the element connected with a hyperlink, its shape will change. If the user clicks on this element the contents of the link will be executed. This offers the possibility to connect attributive alphanumeric data, like HTML-pages or database utilizations. Also the change to other sceneries like the interior can be reached.

5. RESULTS AND BENEFIT

The result of the visualisation is a VRML-Code in which the spectator can navigate respectively following on his own ideas. It gives an impression of the object which nearly reaches the original appearance. Additionally alphanumeric information generated out of databases can be placed and called up via hyperlinks. The publishing of all this information in the internet leads to multifunctional object related information systems. The presentation by virtual reality is not very new. But the discussion in this place demands a correct and reality based geometry, which means a measured geometry. Figure 4 shows a comparison between the real entrance hall and the corresponding virtual reality.

Fig 4: Comparison of reality and virtual reality

The presented works cannot be justified by a proper presentation. So a benefit has to be demanded too and possible users are to be named:

– Public institutions can offer their clients an information system. With this the clients can be informed “where to find what” and how to get there.

- Hotels, castles, museums, etc. can be presented in the internet by the keyword virtual museum.
- Realtors get the chance to present their offers in a more effective way and make the objects virtual passable.
- Etc.

There is the chance to present the objects to a wider public. The clients are able to have a realistic view from any distance. A possible walk through lead to an inspection without any pressurize. In case of rejection of an offer, much time and effort are saved because there is no need to visit the object.

Although the techniques are not very new, they are not common. In most cases VRML is used to show exterior sceneries. Here we find a scenery which combines exterior and interior sights. And this scenery is founded on detailed measurements. So not only a realistic look is given but also correct geometry.

During the work the visualisation of the essential characteristic of the total object was dominant. Especially the architectural fastidious new building and its representative entrance hall have always been in the fore of the works. The results of this example can be seen on
http://www.fbg.fh-frankfurt.de/wir/kehnep/downloads/htm.
(Use Microsoft Explore with COSMO-Player)

The given visualisation spreads over two files which are connected by hyperlinks. The file for the exterior scenery has a size of 4 MByte, 269 KByte compressed the interior scenery is 244 Mbyte, 201 KByte. The textures are loaded when needed. So additionally another 1 MByte up to 5 MByte for the exterior and 400 Kbyte and 2 Mbyte for the interior scenery are necessary.

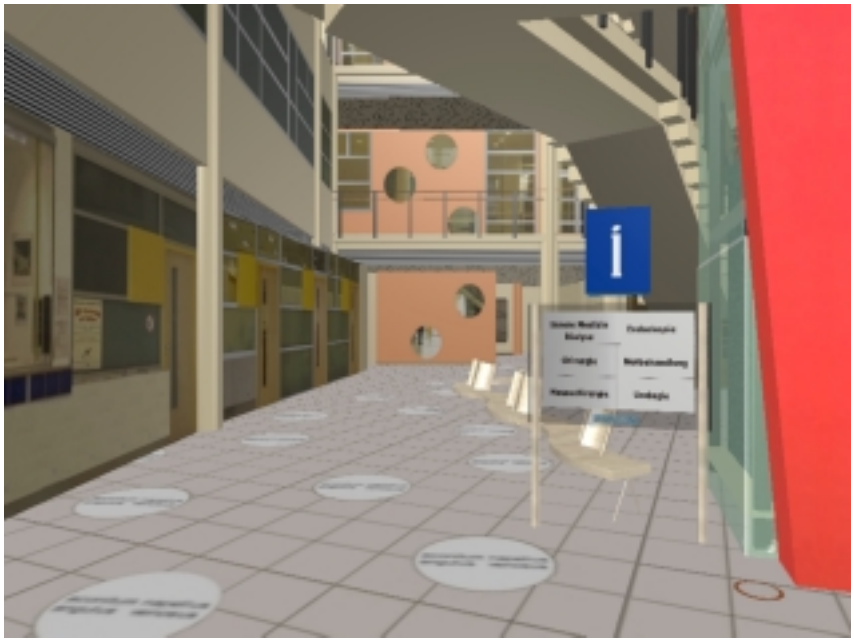

Fig 5: Inner sight of the entrance hall

The surveying engineer is the expert for collecting and presenting spatial data: The explained techniques gives him the duty and the chance to present the result in the medium of internet. He is able to lead his measurements to three dimensional coordinates of points. In GIS he deduces objects and fulfils the related attributes. The new tasks are to handle three dimensional objects to construct them in CAD and transfer them to a virtual reality. As well he is used to handle with alphanumeric information.

This gives the chance for further products. Because the surveying engineer has always implemented new technology into his work the virtual reality can soon be a normal part of contracts. Additional to lists or files of coordinates, digital or analogue maps or plans virtual world can now be points in the range of products. They increase the value of produced data immensely and open a new market for the surveying profession.

6. CONCLUSION AND PROSPECT

This paper gives an example of a geodetic work which includes not only the task of producing a traditional plan but also making a visualisation. This means that the two dimensional analogue products have changed to a three dimensional digital one. All data are based on conventional geodetic measurements. So visualisations can be regular element in the range of surveying works. Surveyors are used to the techniques of databases and GIS. The one discussed here is a replenishing of ranges which can be offered.

VRML will be extended. It will offer the user working with geodetic coordinates including the questioning from coordinates of any point. Coming closer to objects the visualisation becomes more detailed in steps, the user can define. In 2002 X3D (Extensible 3D) format will be finally defined. VRML becomes more realistic.

The technique is more than a toy. With it the surveyor will get a better tool for presenting his work. Soon 3D-Visualisations will be as normal as digital data are today.

REFERENCES

Däßler, Rolf (1999): *Das Einsteigerseminar VRML*, Kaarst (bhv).

Festschrift zur Einweihung (2000): *Baudokumentation Funktionsneubau Krankenhaus Hohe Warte,* Hrsg.: Staatliches Hochbauamt Bayreuth

Kehne, G. et.al. (2001): *Gebäudevisualisierung und Darstellung im VRML-Format für Internetpublikationen*, Vermessungsingenieur, Heft 5, Oktober 2001

Nävy, Jens (1998): *Facility Management: Grundlagen, Computerunterstützung, Einführungsstrategie, Praxisbeispiel*, Berlin, Heidelberg (Springer-Verlag)

Schlüter, Oliver (1998): *VRML Sprachmerkmale, Anwendungen, Perspektiven*, Köln (O'Reilly).

Schmidt, Benno / Uhlenküken, Christoph (2000): *Sichtbare Verbesserungen – Trends der 3D-Geodatenvisualiserung*, GeoBIT, Heidelberg (Wichmann/Hüthing)

Schröder, D (2000): *Abbildungskonzepte, Techniken und Werkzeuge zur 3D-Visualiserung von Geodaten* in: Mitteilungen des Landesverbandes Baden Württemberg, Stuttgart, (DVW).