# Platform Independent Visualization of DICOM-Datasets in 3-D VisualMediJa

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**Abstract.** VisualMediJa is a tool for the administration, 2-D and 3-D visualization and diagnostics of DICOM-conform images. It offers a Graphical User Interface (GUI), which allows multiple interactions with images, e.g. choosing of a point of view on a 3-D object or laying virtual image slices through the images. The GUI is freely configurable. By the positioning of acquired or even virtual image slices a differentiated anatomical analysis becomes feasible. Topographic details may be viewed in independent 2-D or 3-D windows and may be optimally arranged for the finding. Views, pan-shots and documentations can be stored.

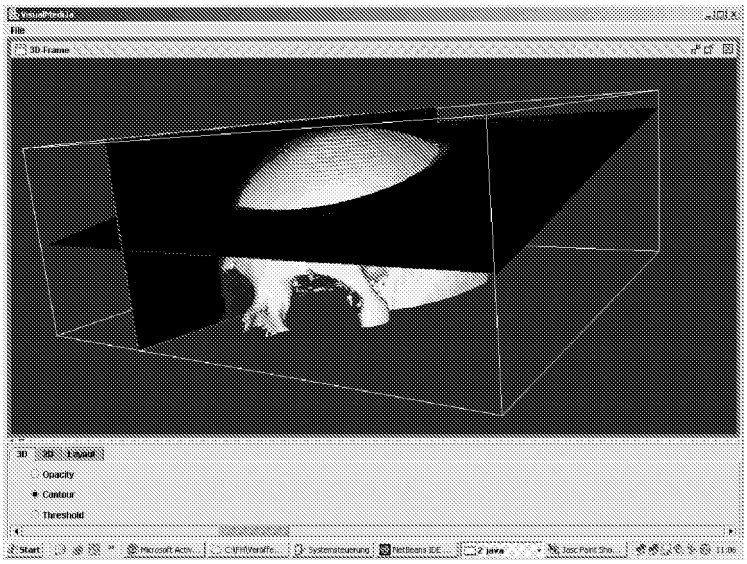
## 1 Introduction

Tomographic images – e.g. CT, MRI, PET, and sonography – are frequently used in clinical diagnostics. Communication, archiving and documentation of these datasets can be implemented by proprietary solutions. But in a heterogeneous system environment the use of DICOM and web-based solutions is more flexible and future-proof.

In principle it is possible to visualize DICOM-data in 3-D but normally 2-D-Images (cross sections) are used for clinical diagnostics. The exploration of such images may be difficult for some reasons, e.g. when essential anatomical structures do not fit to the image orientation. By three-dimensional visualization finding becomes more intuitive and in consequence diagnostic quality is enhanced.

Furthermore DICOM is not capable of processing and record 3-D-objects. Therefore no information of convenient visualizations can be stored. Also there is no way to document which of the numerous established procedures for three-dimensional visualization is used. Further on in the DICOM-standard cannot be told which aspect is suitable for diagnostics or therapy-planning. This is e.g. the enlargement of an object, the viewing angle or the position of a virtual slice. So DICOM has only limited capacities of archiving diagnostic findings in volume datasets. The use of DICOM Structured Reports for such a differentiated documentation is barely tested.

**Fig. 1.** A 3-D-Reconstruction of a CT-Image (a head) with two virtual slices.




## 2 Material

For developing VisualMediJa following programs are used:

- J2SE v 1.4.2 [1]
- Netbeans IDE v 3.5.1 [1]
- VTK Nightly Release (version from 19.11.2003) [2]

The developing platform is a notebook with an Intel Pentium$^{TM}$ IV CPU, 1024 MB RAM, a GeForce4 440 graphic card with 64 MB RAM and runs on Windows XP$^{TM}$ Professional.

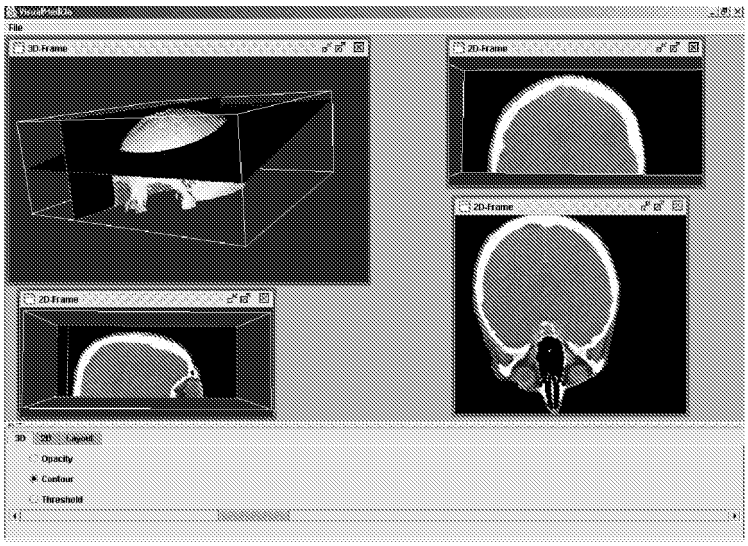
## 3 Methods

The use of Java allows the development of a platform independent visualization program. Due to the internal security-manager of Java it is possible to implement a web-safe program with minor development effort and at low cost.

Visualization with Java is preferably being done with the "open-source" products Java3D or VTK. But only VTK is a complete visualization toolkit with a multiplicity of rendering functions and hundreds of image processing filters. In addition it is widely spread in the community of medical image processing.

The integration of VTK in the GUI of VisualMediJa is realized by the using of a JInternalFrame-object (package: Swing) whose content pane consists of a modified canvas-object (package: AWT). This object contains the rendering-window that carries out the visualization process.

**Fig. 2.** A CT-Image (a head) with two virtual slices inside a 3-D-Frame and three additional slices in separated frames.




During the reading-process that is realized by a modified vtkDICOMReader [1] DICOM-data will be converted into a polygonal data format, which can be visualized by VTK (Fig. 1). Different Readers allow the program to load a various number of 2-D- and 3-D-datasets (jpg, vtk, img...). To accelerate the developing process all loaded datasets are converted into the same internal format. Due to this every new function needs only to be implemented once and it works for all loaded datasets.

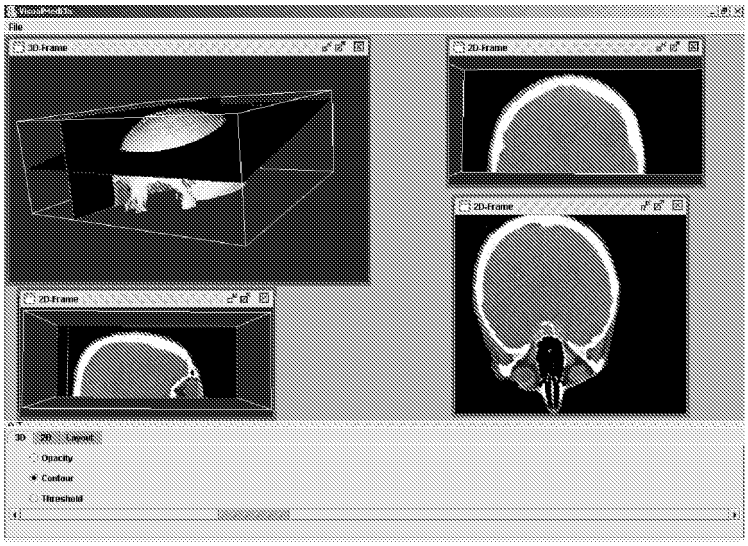
The Virtual-Slices-Technology allows the user to place slices at any position, in an optional orientation and at a user-defined size inside the visualized dataset. So he is not constricted to the recorded slice-orientation. This enables the user a better view on the region of interest e.g. a special organ or a tumour. These regions of interest can be recorded as jpeg-images and whole pan-shots as avi-movies. It is also possible to store documentations in text-files.

Furthermore VisualMediJa is based on the MDI-concept (Multiple Document Interface). So the simultaneous visualization of different volumes or slices in independent windows is possible as seen in figure 2 and 3.

## 4 Conclusion

Diagnostic findings and operation plannings can be done with recorded image slices. By the use of visualization and interactive manipulation of 3-D-Images more information can be gain. In particular the positioning of multiple (virtual) slices allows a more differentiated and topographic more exactly diagnostic finding and operation planning by examination of independent forms of visualization

**Fig. 3.** To enable a better view on images the toolbars can be removed (see figure 2).




– 2-D and 3-D. The possibility of storing images, pan-shots and documentations makes it basically possible to use VisualMediJa as an operation planning tool.

These functions allow a better diagnosis due to an improved visualization of the patients' anatomy. The capabilities of visualizing DICOM-datasets in 3-D and being platform independent offer a wide application area for VisualMediJa.

## 5 Discussion

The whole concept of VisualMediJa makes it basically possible to integrate it in existing Java-based diagnostic systems. It is only necessary to develop a proper interface to enable the communication between VisualMediJa and other visualization tools. (This is already realized with JiveX [3].)

The window-based concept of VisualMediJa allows the user to configure an individual and for the actual diagnostic reasonable GUI. This allows – combined with the free definition of virtual slices – a differentiated inspection of 3-D-images.

At the moment the diagnostic findings documented by this tool cannot be stored DICOM-compliant, but develop proposals for corresponding DICOM-enhancements are planned at a later phase of this project.

## References

1. Sun Microsystems, Inc., Santa Clara, USA, java.sun.com
2. Kitware, Inc., New York, USA, www.kitware.com
3. Visus Technologie Transfer, Bochum, Germany, www.visus-tt.de