Interactive spatially aware visualization of medical images

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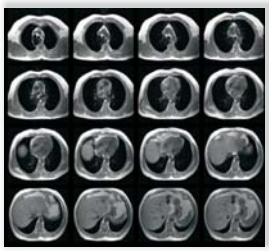
Purpose

Develop a system where the exploration of internal anatomy occurs directly on the surface of the real body as if the doctor had "X-ray vision". We hypothesize that this would make visualization and exploration of the inner anatomy a more intuitive and natural procedure when compared to traditional visualization methods.



The process pf analizing images slice-by-slice is tedious and inefficient.

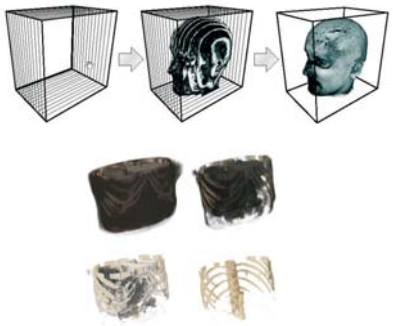
Use of expensive workstations for volume visualization is non-intuitive and requires focused training.

The desired system

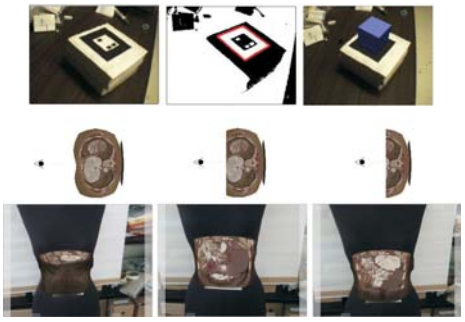
Allow the doctor to visualize the inner structures of a patient's body, using a mobile display (tablet PC) as a see-through device with semi-transparence and opacity.
Problems:
- Processing capacity in mobile displays.
- Tracking of the environment to associate the volume to the human body.

Methods

To solve the problems described above we combined two techniques: volume visualization and augmented reality.
Requirement: the system should run on commodity personal hardware.



Development of an optimized volume visualization based in an efficient texture mapping technique. The volumes are generated from CT.

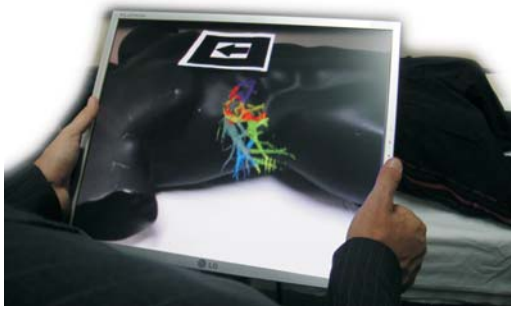


AR is obtained through video tracking of fiducial markers. The volume generated is associated with a marker. This marker is tracked by a webcam through computer vision to define a dynamic pose for the virtual camera. Volume and video are mixed and displayed to create augmented reality.

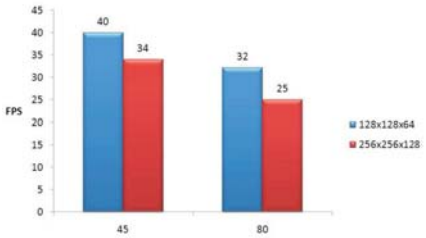
Results

The system has been conceived to be used with a tablet PC, which allows touch screen interaction.
The video of the real world (patient's body) and the volume (patient's scanned images) are fused in 3D and rendered on the display according to the position and angle of the user/physician handling the device.

Participant can hold the tablet vertically while moving in the environment. The device becomes a window to the virtual world.



When an object of interest, e.g. a patient, is focused, their internal structures are rendered according to the angle and position of the participant.



Performance comparison for the average use case using two different dataset resolutions. The x axis is the distance in centimeters from the screen to the volume.

Conclusion

The system proposed allows for a novel paradigm of interactive study of the human anatomy which is compatible with current commodity hardware and built up with low cost software components.
Possible aplications:

Teach anatomy and pathology in different levels, from the primary school up to postgraduate.

Physician's office, helping them to show to patients and relatives, in an intuitive and visual way, where the pathologies are.

Ongoing studies should verify if the system could effectively be applied in image analysis with the purpose of disease determination.

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