Augmented and Virtual Reality Applications to show complex spine pathologies: first version


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Introduction

- Visualization of the spine and his malformations (herniated disk, foraminal stenosis, spine stenosis) is a challenge.

- Augmented Reality is the combination of a real scene supplemented (or augmented) by computer generated information (image, video, sound)

- Android based mobile devices (smartphones, tablets) are being increasingly massive adoption and with higher performance characteristics
Material and Methods

- Patient: male, 57 years old

- MRI: Sagittal 2D T2w TSE sequence (TR 4420 ms, TE 130 ms, FoV 320x320 mm, Voxel Size 0.7x0.7x3.0 mm)

- CT: Sagittal CT (voxel size: 0.3x0.3x1.0 mm)
Material and Methods

- CT - MRI co-registration: “Linear registration” algorithm, software 3D Slicer v 3.6.

- CT segmentation: threshold option (113, 1303 Hounsfield units), software 3D Slicer v 3.6

- L4-L5 vertebral bodies was extracted manually using ImageJ v1.49n
Material and Methods

- L4-L5 intervertebral disk segmentation: “simple region growing” algorithm, 3D Slicer. Clean using ImageJ.

- L4-L5 vertebral bodies and intervertebral disk mesh generated using “Model Maker” algorithm, 3D Slicer software. Smoothing using “HC Laplacian”, MeshLab software.
Material and Methods

- Android application were created using:
  - C# language
  - Software tools: Unity 5, 3ds max 2016, Meshlab v1.3.3.
Results

• Focusing printed target image using Android app, the 3D spine of the patient was shown with two vertebral bodies and intervertebral disk.

• The user can rotate the spine by rotating the view angle over the target image, or rotating the target image itself.
Results

- The size of the spine can be changed by modifying the distance between the mobile device and the target image.
Results
Discussion

• The application:
  - Demonstrates the fusion of augmented reality techniques with medical images of patients with spine pathologies.
  - Shows how to use ubiquitous mobile devices to display advanced medical information in a 3D interactive application.
  - It is useful to show, explain and describe in a 3D and interactive way the spine pathology of the patient.
Discussion

- Augmented reality demonstrated new views from inside spine and relationship of normal structures and different pathologies.

- More work must be done to create an automatic CT-MRI registration and segmentation of vertebral bodies and intervertebral disks.
Disclosure Declaration

None of the authors report any conflict of interest.