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A Virtual Reality Environment to Visualize 3D Patient-Specific Models by a Mobile Head-Mounted Display

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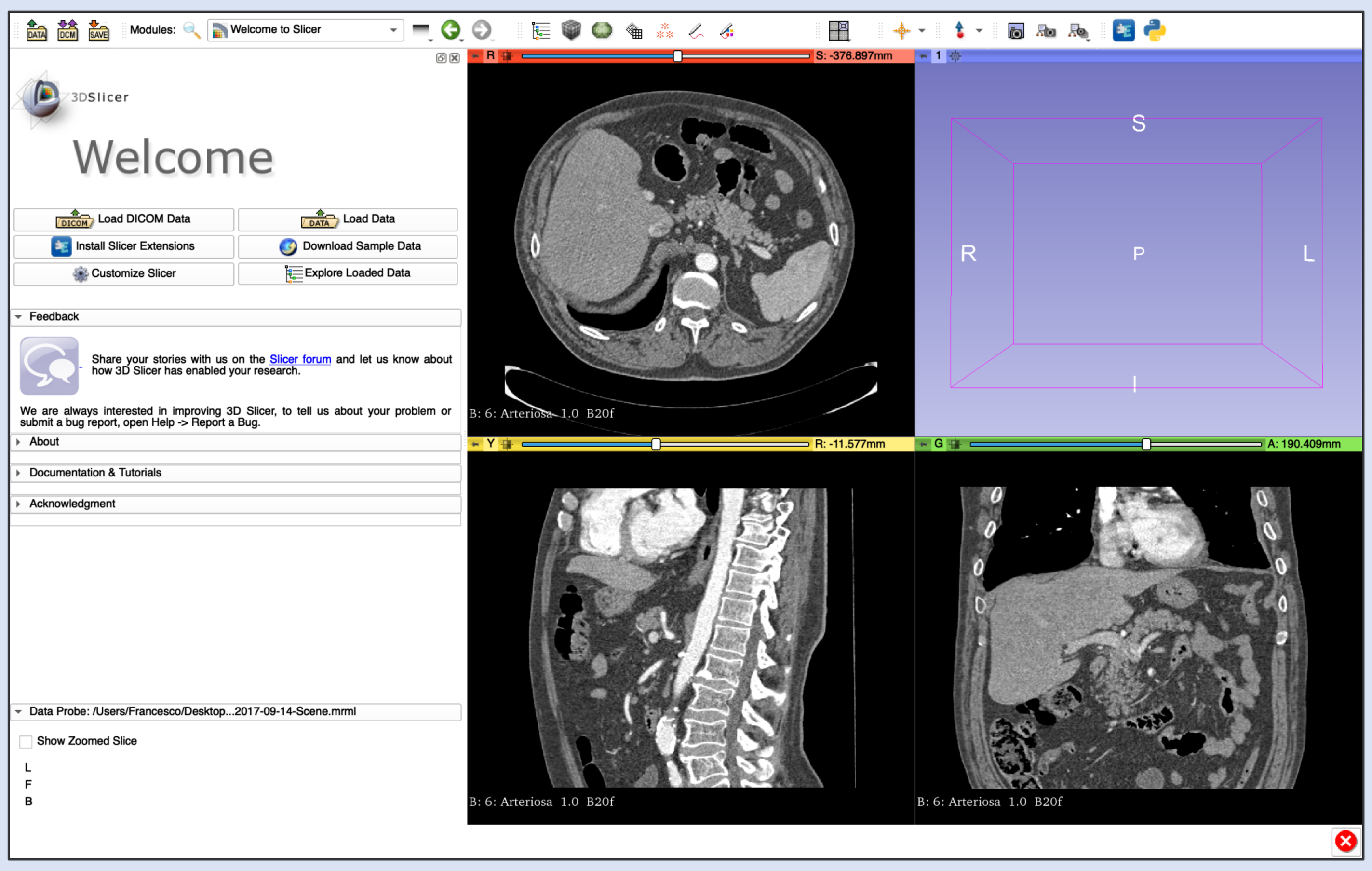

Fig. 1 – A CT/MRI dataset is imported in 3D Slicer.

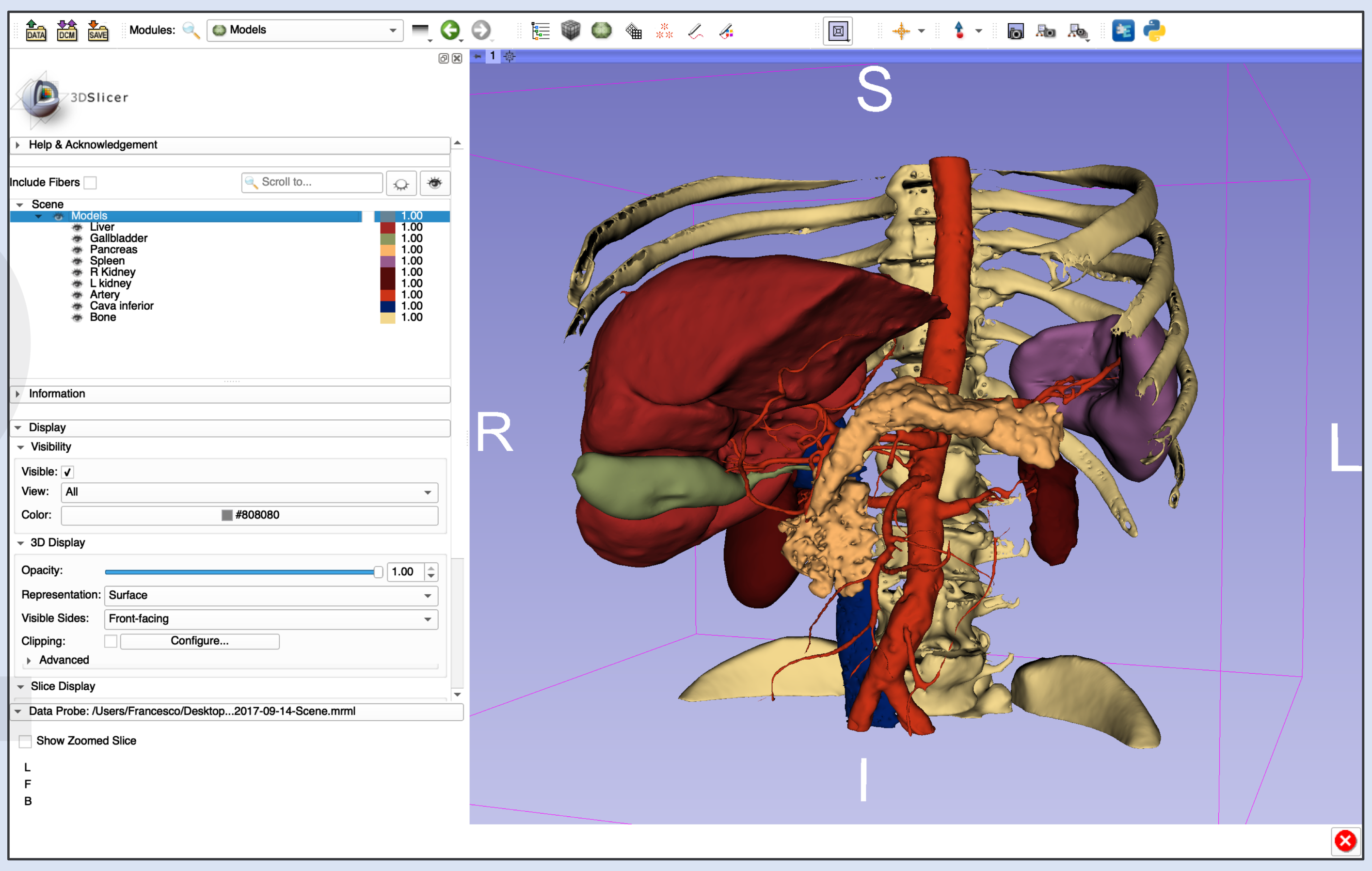

Fig. 2 – The CT/MRI is three-dimensionally reconstructed in 3D Slicer

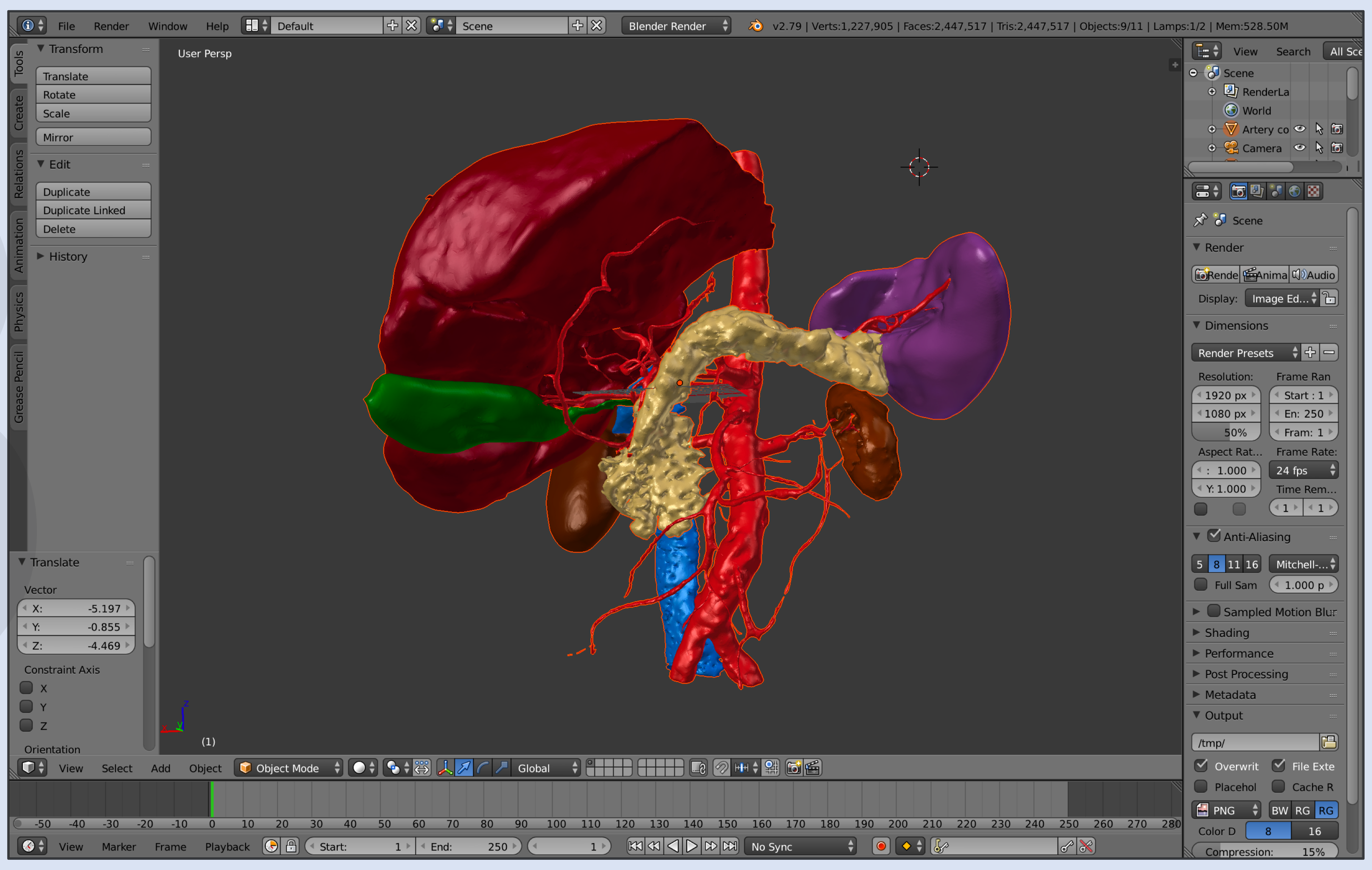

Fig. 3 – The 3D models are imported in Blender to adjust and refine the scene.

Fig. 4 – The scene is imported in a new Unity project. All the necessary libraries and scripts are imported. Then the project is compiled and the app is built.

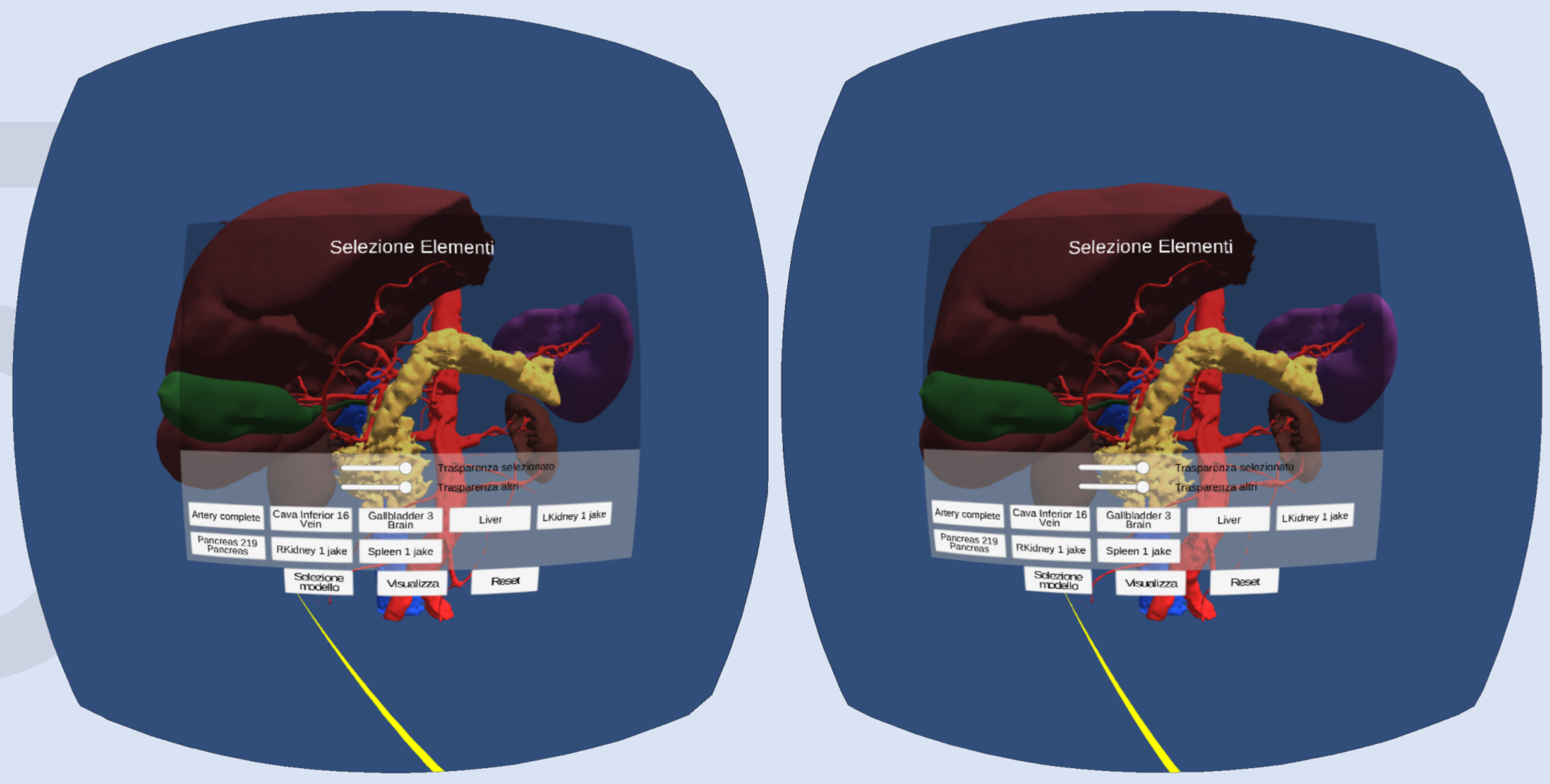

Fig. 5 – The app is installed, loaded and visualized using the HMD.

BACKGROUND

With the availability of low-cost Head-Mounted Displays (HMDs), Virtual Reality Environments (VREs) are increasingly used in medicine for teaching[1,2] and clinical purposes[3]. Our aim was to develop an **interactive, user-friendly VRE** for tridimensional visualization of **patient-specific organs**, establishing a **workflow** to transfer 3D models from imaging datasets to our immersive VRE.

MATERIALS AND METHODS

This original VRE model was built using open-source software and a mobile HMD, Samsung Gear VR. For its validation, we enrolled **33 volunteers**: morphologists (n=11), trainee surgeons (n=15) and expert surgeons (n=7). They tried our VRE and then filled in an original **five-point Likert scale six-item questionnaire**, considering the following parameters: ease of use, anatomy comprehension compared to 2D radiological imaging, explanation of anatomical variations, explanation of surgical procedures, preoperative planning and experience of gastrointestinal/neurological disorders. Results in the three groups were statistically compared using **ANOVA**.

RESULTS

Using cross-sectional medical imaging, the developed VRE allowed to visualize a 3D patient-specific abdominal scene in **one hour**. Overall, the six items were evaluated **positively by all groups**; only anatomy comprehension was statistically significant different among the three groups.

DISCUSSION

We established a workflow to transfer 3D virtual models derived from medical imaging into immersive VR in a time consistent with clinical practice using only open-source free softwares. Analyzing the results, we figured out that our VRE could be applied in a variety of fields related with medical education, such as **improving comprehension of anatomy** and its clinically-relevant variants or **allowing trainee surgeons to practice** both basic skills and custom-based surgical procedures in a patient-safe and cost-effective way[4,5].

CONCLUSIONS

Our approach, based on open-source software and mobile hardware, proved to be a valid and well-appreciated system to visualize 3D patient-specific models, paving the way for a new possible tool for teaching and preoperative planning.

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