

Update: Quality Control/Quality Assurance for the Human Reference Atlas and On-Ramping to the HuBMAP Portal Using the HRA Organ Gallery in Virtual Reality

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HuBMAP: NIH WG Meeting | Virtual | October 31, 2023

Our JumpStart Award

Name	Professional Title	Role on Project	Institution
Andreas Bueckle	Research Lead	JI	Indiana University
Lu Chen	PhD Student	JI	Stony Brook University
Katy Börner	Distinguished Professor	PI	Indiana University
Fusheng Wang	Associate Professor	PI	Stony Brook University

Vision...

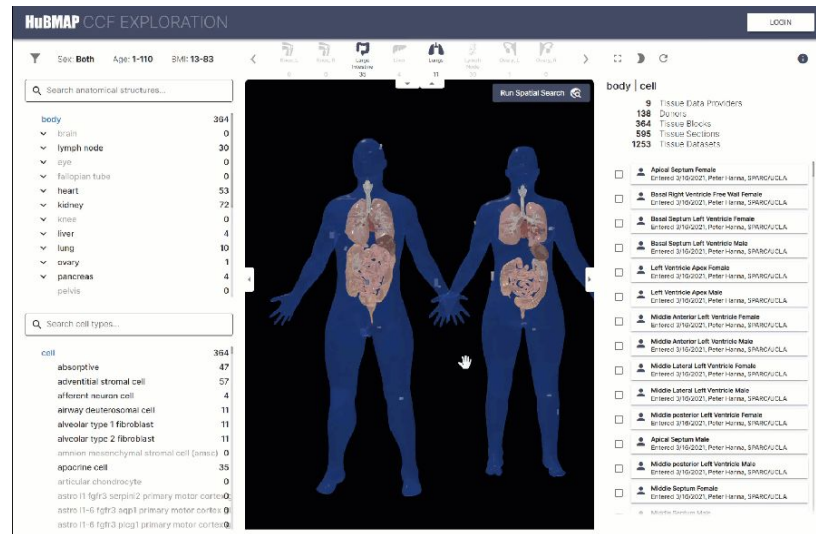


<https://medcitynews.com/2019/09/the-benefits-of-ar-in-healthcare/>

Application: The Human Reference Atlas Organ Gallery in VR

CCF Exploration User Interface (EUI)

- Human Reference Atlas (HRA)
 - comprehensive, three-dimensional (3D) atlas of all the cells in the healthy human body
 - Compiled by an international team of experts who develop standard terminologies that they link to 3D reference objects, describing anatomical structures.
(<https://www.nature.com/articles/41597-023-01993-8>)
- The Exploration User Interface (EUI) allows exploring the Human Reference Atlas spatially and semantically

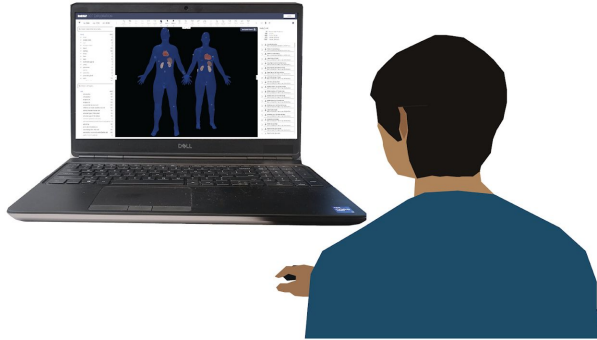


<https://portal.hubmapconsortium.org/ccf-eui>

What if...?

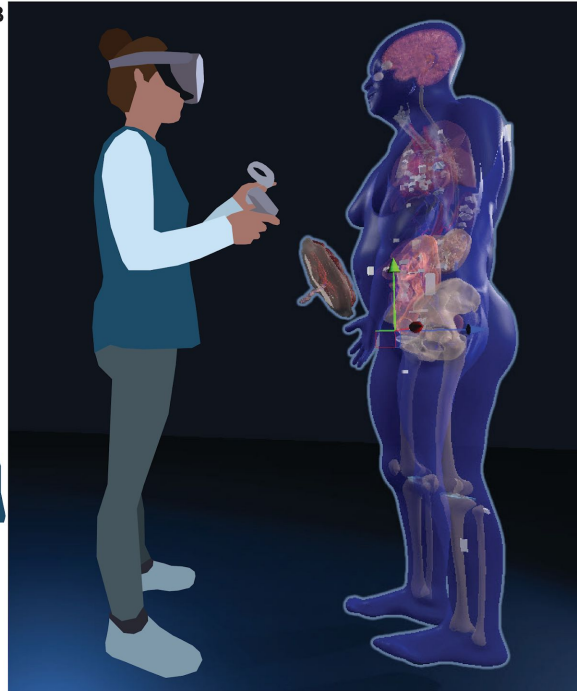
What if...?

A



2D screen

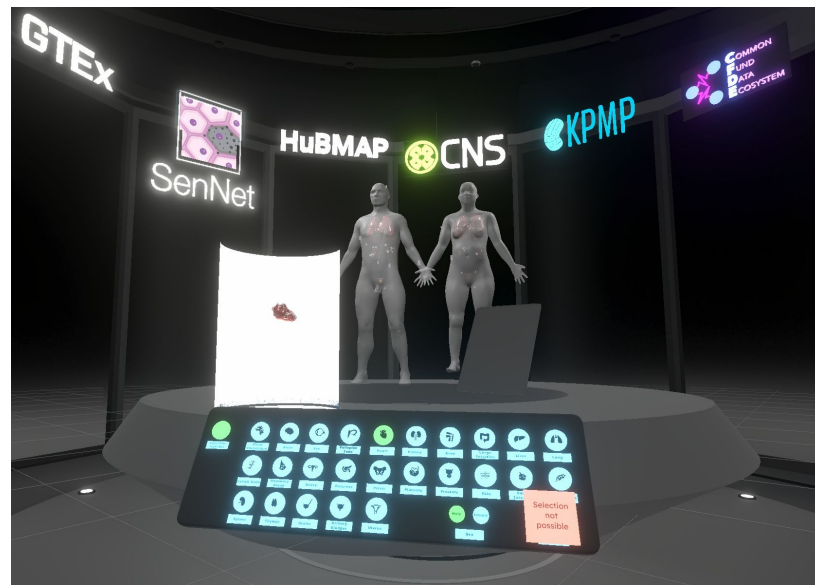
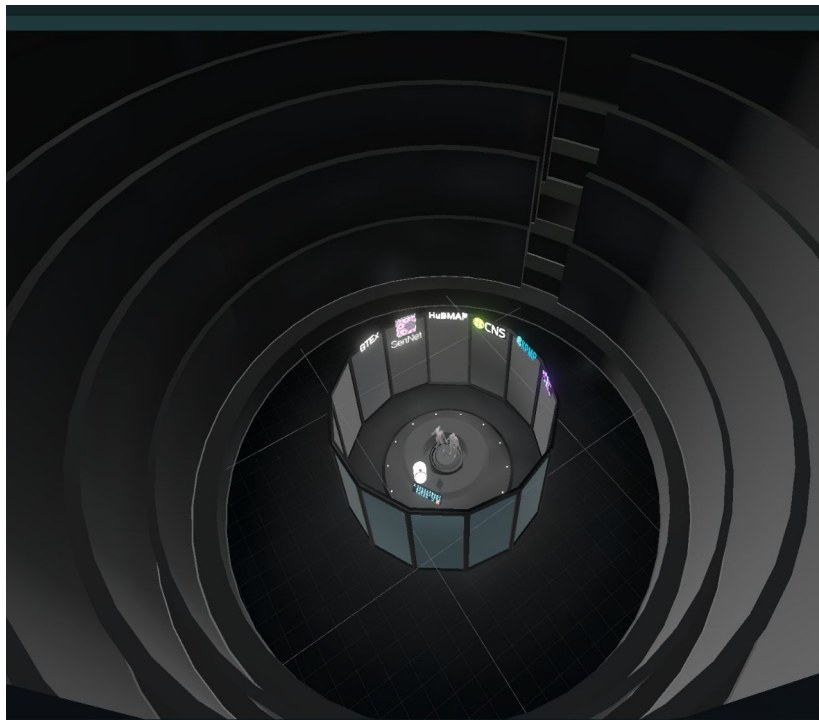
B



HRA Organ Gallery (VR)

<https://doi.org/10.3389/fbinf.2023.1162723>

Current Status



Updates

- Hackathon held successfully!
 - Increased mean FPS from 30 -> 65 (target/max: 72)
 - Reduced #triangles from ~4.2 mil -> ~930k
 - Improved usability of keyboard
 - Added lightbox for better screenshots
 - [Notes](#)
 - [GitHub issues](#)
- Second hackathon in SP 2024 optional

External Milestones Y1 (June 1, 2023 - July 31, 2023)		
▶ Aim 1: Develop and publish the HRA Organ Gallery on the Oculus Meta Quest 2 VR headset. 1 4		Andreas Bue...
▼ Aim 2: Organize one to two hackathons as an opportunity to test the HRA Organ Gallery with experts and develop it further. 2 2		Andreas Bue...
Hold kick-off call and establish ongoing working relationship with NIH 3D team for first hackathon (for Aim 2)		Andreas Bue...
A hackathon with notes, documentation, has been held.		Andreas Bue...
▶ Aim 3: Produce a series of video tutorials and other documentation that will be supplemental to the application itself. 2 2		Andreas Bue...
Add task...		
Internal Milestones		
▶ Disseminate the application 2 2		Andreas Bue...
▶ Prepare next release 2 2		Andreas Bue...
▶ General visual enhancement 3 3		Andreas Bue...
Develop visualization component for CT summaries		Andreas Bue...
▶ Improve performance 1 1		lu.chen.3@st...
Submit paper describing full application (and hackathons?) to Nature Scientific Data		Andreas Bue...
Compile a user manual 1 1		Andreas Bue...
Make VR piece with TOO MAP from Das Blut		Andreas Bue...
▶ Interview KPMP patients for insights on Embedded Data Stories use case 1 2		Andreas Bue...
▶ Submit Brief Research Report to Frontiers in Bioinformatics 3 3		Andreas Bue...
Run user needs analysis		Andreas Bue...
Implement tracking for app usage		
Implement explainer piece for Devin + Peter		

Just Completed: Hackathon with BCBB/NIAID

Workshop Organizers



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<https://cns-iu.github.io/workshops/2023-10-18-nih-3d-hackathon>

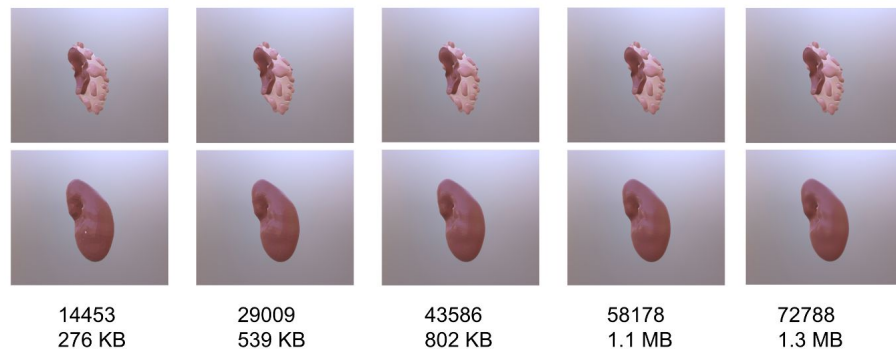
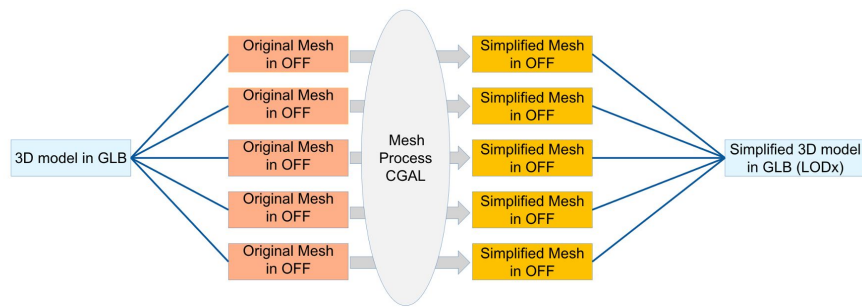


Level of Detail (LOD) Model Generation and Optimization

Reducing 3D model rendering time & increasing frame rate

Completed

- Developed a converter between different formats for 3D models
- Proposed an efficient and automatic workflow to create LOD models using CGAL (Computational Geometry Algorithms Library)
- Multi-LOD models are created and generated



Future Work

— — —

- Use Blender and its Python API to generate Multi-LOD models in GLB
 - CGAL can only handle meshes with vertices, edges and faces. However, meshes always have other information, like lighting and material, which will be missing if using CGAL
- Mesh refinement for computation purpose
 - Some meshes with holes or manifold problems can be used for visualization but not computation
 - How to refine these meshes but also keep the biological correctness is important