



The First Open Source 3d Atlas of Human Anatomy

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Received: May 04, 2022

Published: May 30, 2022

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Abstract

This article presents the open-source 3D atlas of human anatomy called 'Z-Anatomy', started in march 2021. This atlas contains a modified version of the open-source models made by the japanese organism called 'BodyParts3D' around 2012.

The software used to modify and visualize the model is a modified portable version of 'Blender' -an open-source 3D software-. A tailored python script adds a serie of functions that allow to create labels, import and display the definitions, translate all the anatomical structures in several languages, use cross section planes, toggle on/off a key color system, select any level of the hierachy, etc.

Both the content and the the software have been modified to be usable as a complete atlas of anatomy with adapted functions.

As this blend file can only be used on desktop computers, it is organized so that its hierarchy can be imported in 'Unity'-a software used to create applications or games.

An mobile application has then be made in 'Unity' and can be used on mobile devices (Android >11); its open source code is shared on Github.

Keywords: Anatomy; 3D; Open Source; Blender; Education

Abbreviations

TA: Terminologia Anatomica-1st Edition (TA-1998);
TA2: Teminologia Anatomica-2nd Edition (TA2-2019); FMA:
Foundational model of Anatomy

Introduction

Traditionally, an occidental student of any medical discipline spends between 100 and 400 euros to buy anatomy books that they will keep for life and that can be given to somebody else afterwards. Nowadays, the numeric technologies are rising and so do the anatomical content. Often used in addition of printed material, the tools offered by the 3D softwares have the advantage to be seductive, more interactive, and lighter when used on a mobile device. Some are free, some have free content and some are pretty complete, but none of them is open source.

What added value would an open-source atlas have?

As an open tool, it would be

- Free forever and for all, protected by the 'Creative Commons' licence
- Respectful of its user's privacy
- Accessible without connexion

It would empower the user thanks to

- Blender, an evolving and modular tool that allows the members of any discipline linked to the human health to participate
- The technical support of thousands of Blender users connected through tens of forums in many languages and hundreds of tutorials available on the net.

More than just an official dictionary of terms and shapes, it would inform about their relations

- Only and all the official updated terminology (TA, 2nd Edition, 2019) represented.
- A polymodal hierarchical organisation of the structures and a serie of selection options.
- The details, or recognisable zones of the structures
- The muscles insertions on the skeleton
- The motor and sensitive territories of the nerves
- The orientations, regions, joints and movements of the body.
- Color-based mind-mapping strategies (innervation, vascularisation, function).
- Biomechanical content and interactive animated movements
- Ready-made views showing specific regions of interest
- Searchlist options for a more efficient way to isolate the structures of interest

The choice to keep the project integrated within a professional 3D program, although it closes the access to all the mobile users, raises one or two obstacles, and implies the user to read a short user guide before using it for the first time, makes actually a great difference in comparison with all the other tools on the market

- Beyond the traditionnal 'rotate', 'pan' and 'zoom' options, the complete navigation kit used by professional 3D artists
- Beyond the traditionnal selection arrow, the complete selection kit used by professional 3D artists
- Beyond the traditionnal render, the whole serie of customisable rendering options for the realtime 3D view, the export of images and videos (lights, materials, animations, video editing, subtitles, field of view, fog, emission, transparency...).

The idea to try and develop an open-source project without any funding, while several serious solutions are already provided by private organisms may seem missing the concept of paying for quality; but it actually allows the user to configurate the tool to corrspond to his particular needs

- Some may want to use it to print 3D anatomical regions for teaching purposes
- Some other to create assets for a serious game about anatomy
- A third one wants to create a complex model of biomechanics adding motion capture
- Another one wants to use it to conceive customisable 3D printable orthosis

None of these uses are achievable with the proprietary solutions.

The purpose of an open anatomy atlas is to fill the gap between the too complex approach of the research centers and the simple but limited approach of the proprietary software meant for end-user

- The research centers invented languages to allow non coders to interact with the data usually managed only by coders: The SPRQL, OWL, and RDF languages. At the opposite of the traditionnal file explorers, these languages organise data blocks using relation-type data blocks. Is is powerful but not used outside of the big data research centers.
- At the other hand, the anatomy atlases propose intuitive apps that allow to do certain things without confusing the average user

Thanks to its latter evolutions, Blender now provides all the tools to reproduce and navigate through the complexity of these >7000 anatomical structures. Its quality and broad community allow all the contributors to take part in the development of this free atlas.

The method developed to organize the file allow it to be integrated in the application in a minimum of time to become available to all the mobile users.

Materials and Methods

- **Blender (Blender.org):** The open-source 3D software used to edit and visualize the models on desktop PC.
- **Unity (unity.com):** The 3D software used to create the app.
- **BodyParts3D (dbarchive.biosciencedbc.jp/en/bodyparts3d):** Advanced open-source 3D models of anatomy, hundreds of coherent segmented parts.
- **TA2 (ta2viewer.openanatomy.org)**

Results and Discussion

After one year of development, an elegant up-to-date organized model of anatomy can now be read both on desktop computer with a serie of tailored functions, and on Android >11 mobiles through the app.

A community of interest is growing around the project on LinkedIn ([linkedin.com/company/z-anatomy](https://www.linkedin.com/company/z-anatomy/)).

A grant has been obtained by the University of Leiden (Holland). The project will be developed further in partnership with three other universities (Maastricht, Utrecht and Leuven).

All the content, the script and the code are shared under CC-BY-SA license. This license not only gives free and unlimited access to both the content, the software, and the app's code, but also prevents any appropriation of any of its content by privately owned companies.

More development is needed (verification of the translations in several languages, completing the missing parts, adapting the app to other devices, improving the UI, create a collaboration platform, ...) and will probably be provided shortly by the emerging community and upcoming academic supports and partnerships [1].

Conclusion

The combination of open-source high-quality models, of a competitive 3D software (that also happens to be open source) with the work done to optimize their interaction and to translate them into a mobile application create a very fertile environment for many actors active in Health education and visualization.

Website: <https://www.z-anatomy.com/>

Presentation: <https://www.youtube.com/watch?v=fAITXJE8ECA>

Tutorial: <https://www.youtube.com/watch?v=Jlxjnw1ARhs>

LinkedIn page: <https://www.linkedin.com/company/z-anatomy>

Application: <https://play.google.com/store/apps/details?id=com.LluisVinent.ZAnatomy>

WebGL: <https://lluisv.itch.io/z-anatomy>

Github: <https://github.com/LluisV/Z-Anatomy>

Acknowledgements

- Marcin ZIELINSKI (*Poland*) created all the python script that turns blender into an Anatomy visualizer, by adding several functions (translations, labels, definitions, cross section planes, key color system, ...)
- Lluis VINENT (*Spain*) created all the application on his spare time, while studying for the University. This mobile app reproduces most of the functions of the .blend; it is more intuitive and meant to become the broader public go-to option.

Conflict of Interest

The author of the article has no conflict of interest, except the hope of getting funded to continue developing the project.

Bibliography

1. Wolfgang Dauber. "Lexique illustré d'anatomie FENEIS". Flammarion (2007).