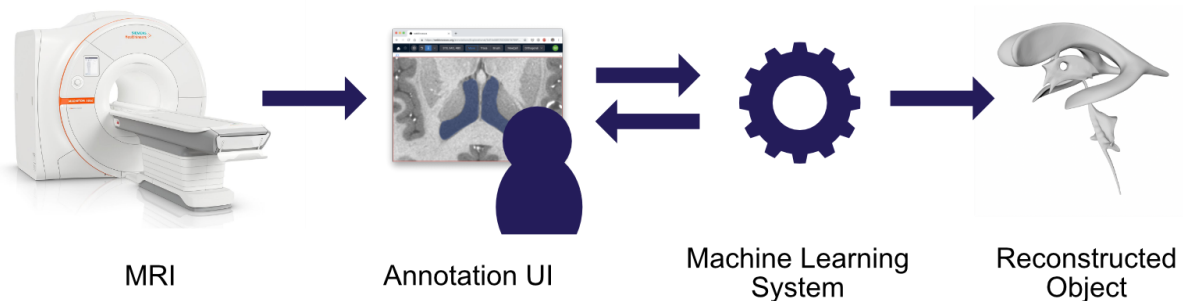


Bachelor's project 2019/20
Digital Health & Machine Learning
Prof. Dr. Christoph Lippert, HPI
Norman Rzepka, Scalable Minds GmbH
Dr. Sonia Waiczies, MDC Berlin

Usable Active Learning Tool for 3D Image Segmentation in Life Science and Medical applications



Motivation

Three-dimensional image datasets from MRI, CT or microscopy unlock a new quality of insights in Life Science and Medical Domains. Unfortunately, these insights are hidden in very large images. Manually annotating this data is extremely laborious and expensive. Therefore, the images need to be processed automatically, in order to extract the information. Current software tools, for example, Freesurfer, are slow or require extensive manual corrections. Unfortunately, manual corrections made by users are ignored and ultimately don't help the software to improve.

Machine Learning (ML) technologies, such as deep artificial neural networks, are well-suited for image segmentation tasks. They are a powerful tool to produce high-quality results on large sets

of images. However, these algorithms require lots of labeled training data which is, again, expensive to obtain.

A new approach called Active Learning (AL) makes the training data generation more efficient. The system directs the user's attention to a specific region in the images to generate labels. This region is selected by an uncertainty prediction. Therefore, only parts that are likely to improve the quality of the ML system have to be labeled.

Active Learning systems have the potential to open ML technologies to new audiences of users. Because it reduces the required amount of labeled training data, even professionals with limited time are enabled to use advanced image segmentation tools for their use case. Therefore, the software needs to be designed in a usable manner for these audiences.

Project Goals

The goal of this Bachelor's project is to design and develop an Active Learning-based Image Segmentation software for MRI images. The software will enable users to manually annotate images while integrating with the Machine Learning backend. As part of the Active Learning approach, the software will suggest areas for the user to annotate. A continuous preview of the automated segmentations will support the user in generating and correcting labels.

- User-centered design of an Active Learning-based tool
- Development of a working prototype with User Interface
- Integration of Machine Learning tools with a continuous preview to the user
- Automated processing of many images in the background
- Evaluation of the prototype with real data and real users

This project will be performed in collaboration with scalable minds, a startup of HPI graduates that builds Machine Learning-based Image Analysis tools for researchers. The project organization will largely be determined by the project participants

What you will learn

- Designing usable systems that are used by professionals
- Engineering powerful systems that integrate with state-of-the-art Machine Learning tools
- How Machine Learning works in the field
- How Life Science and Medical domains draw insights from large image datasets
- 3D data formats and challenges with large datasets

What you should bring with you

- Interest in Machine Learning technologies and automated Image Processing
- Enthusiasm for Life Science and Medical applications