App development for optimized medical image annotation

Project Management and Software Development
for Medical Applications

General Info

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Project Abstract

The development of AI-based algorithms has enhanced medical image diagnosis in recent years. [2, 1]. These advances are not only limited to skin cancer detection [1] or breast cancer screening [3], but can be applied on various datasets in the medical imaging scheme. A prerequisite for a good AI-based diagnosis are algorithms that have been created with correctly and completely labeled data. However, annotating on this large amount of data is a heavy workload for domain experts and slowing the exploration of possible diagnostic improvements. The development of a portable image annotation tool especially for segmentation may represent an opportunity to improve precision and reduce workload for the expert. The goal of this project is to develop a mobile application for time and precision optimized image annotation.

Background and Motivation

- The motivation behind this project is, that modern AI algorithms need professionally labelled data, which are very rare and difficult to obtain
- Previous projects (Hinterwimmer - "Segmentation of nerve tissue in multispectral optoacoustic and ultrasound images", "Schacky, Wilhelm - 'A Multi-Task Deep Learning Model for Simultaneous Detection, Segmentation and Classification of Bone Tumors on Radiographs") have shown, that annotating medical images can be very time consuming and requires the skill of many experts, depending on the task at hand
- To make it as convenient as possible for these experts, an application designed for medical data is needed
- It is the student's task to develop an app for the use on mobile devices for an intuitive and user-friendly use of image annotation
- The main goal is to provide all necessary features for image annotation: classification, object detection and segmentation
- The user interface as well as functionalities - such as zoom, copy segmentation to next slice, etc. – are a crucial part
- To potentially highlight certain features in the images, filter options (negative, enhance contrast) are required
- As an outlook for a potential follow up project/thesis, an integration and implementation for Active Learning [4] might be possible

Student's Tasks Description

- Develop an interactive image "segmenter" for manual object detection and instance segmentation
- Develop an interface for easy dataset loading and exporting
- Provide a manual classification option
- Provide a manual object detection option
- Conduct a small study on manual segmentation results compared to an open source segmentation tool to ensure quality and usability
- Documentation
- The student will learn to apply Flutter/ app development to real life medical obstacles

Please send the completed proposal to javier.esteban@tum.de, ardit.ramadani@tum.de, mf.azampour@tum.de and zl.jiang@tum.de. Please note that this proposal will be evaluated by the BMC coordinators and will be assigned to a student only in case of acceptance.

- He/she will be introduced to today's machine learning challenges and will get insight into the chair of orthopedics´ current big data and machine learning projects
- A scientific and highly educated environment, frequent feedback, meetings and discussion with interdisciplinary students as well as professionals will be provided (depending on Covid-19 situation).

Technical Prerequisites

- In-depth knowledge of app development
- Preferably experience with the Flutter SDK tool
- Basic understanding of how AI algorithms work
- Independent and structured way of working

References

[1] Andre Esteva, Brett Kuprel, Roberto A. Novoa, Justin Ko, Susan M. Swetter, Helen M. Blau, and Sebastian Thrun. Dermatologist-level classification of skin cancer with deep neural networks. Nature, 542(7639):115–118, January 2017. doi: 10.1038/nature21056. URL https://doi.org/10.1038/nature21056

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[4] Li, Xin and Guo, Yuhong. Adaptive active learning for image classification. In Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition, pp. 859–866, 2013.