# OpenTMAS

## *(open-source targeted medical images analysis system)*

Applying for **BND summer of code** on 15.04.2020


Applicant 1:

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# Overview of the Project

The implementation of our idea for a medical images analysis system (openTMAS), based on artificial intelligence and OpenSource would be a disruptive change for the medical imaging analysis, and a sustainable support for the medical experts. The initiative BND summer of code offers us the support we need to prove the feasibility of this project.

In the context of the global outbreak of COVID-19, we saw a sudden increase of patients which puts hospitals and their staff under substantial pressure. The health of every patient depends on the qualification and conscientious work of their doctor and assistants. Especially the analysis of imaging procedures, like CTs or X-rays conducted by radiologists, who are preparing the reports, are to a great extent manually and time consuming. Artificial intelligence can support the analysis and accelerate the process. Publicly available datasets already allow the training of algorithms, with an open data approach, which is essential to reach a new level in practice. Various initiatives are already taking care of cooperation and joint databases. A software solution should be just as open and adaptable and offer the necessary transparency, which can only be achieved through open source. We have been actively involved in a number of online development activities. We interviewed doctors and radiologists who told us that there are local hospitals and hospitals in developing countries that cannot afford expensive commercial medical analysis systems (e.g. Siemens syngo.via) and there is no similar open-source system available so far. An image analysis system is very useful in practice, it increases objectivity, helps the operator with routine tasks, and also allows complex checks against databases.

OpenTMAS (open-source targeted medical images analysis system) is an online assistance system, used to help doctors and radiologists analyze medical images, such as X-rays and CT images. We named it "Targeted" because the objective of our analysis is not general but defined. At present, we focus on the lung analysis, given the condition of patients of usual pneumonia, SARS, MERS, COVID etc. Behind the web application of OpenTMAS there will be the integration of image processing and artificial intelligence algorithms to stimulate the greatest potential of the open source datasets. OpenTMAS doesn’t only focus on image-based analysis, but also integrating the more comprehensive data from the patients (including age, gender, disease history, living area) for a more reliable analysis and prediction.

# Project Goals

The system is expected

1. to be a fully functional, well-looking online system with full user-usability.
2. to analyze the pneumonia patient's condition within acceptable accuracy.
3. to take full considerations of data security, for example, by not requiring users to upload image data to the backend for data protection purposes.

# Feasibility analysis & milestones

## I. Feasibility analysis

This project received a four day proof of concept at an event called coranathon.tech. We were part of it, and we did a research of all the available data, the X-ray segmentation algorithms and related papers, the effect of neural network image reconstruction, and the classification experiments using the combination of images and patient metadata. The results and feedback of potentiel end users show that the feasibility of developing it into a real open source system is very high.

## II. Milestones

- **April - June | Project Initialization**

  comprehensive background research, resource collection, and learning some general medical-related knowledge, academic terminology for lung diseases and descriptions, as well as enhancing and applying necessary tools & frameworks for our system development in the scope of computer science. **This phase ends with a definition of requirements and features.**

- **June - July | Roadmap Design**

  Evaluate the development technique we want to use, prepare AI algorithms candidates, identify the frameworks and programming languages to be used, develop a implement plan, also prepare hardware devices (e.g. GPUs for neural network training). **This phase ends with a selection of algorithms and hardware.**

- **July - August | First iteration of Development**

  Weiling will train in artificial intelligence, and will constantly compare the real results with the results in the papers, trying to improve the results to state-of-the-art. Marcel will define the structure of the site, the front-end

design, the back-end logic, and he will work on the full-stack development of the system. **This phase ends with a test version and a first user test.**

- **August - September | Test Evaluation & Second Iteration of Development**

  Based on the feedback, we improve and strengthen.The second iteration includes another user test. If possible, we'd like to do more development iterations like this. **This phase ends with iterativ optimized beta version of openTMAS.**

## Background of Applicants

(in the attachment you will find our CVs, registration documents, customer reviews etc.)

- Marcel Ochsendorf

  Full-time Bachelor Student of FH Aachen, B.Sc Informatik
  Part-time Freelancer for UKSH and Unimedizin Mainz

  Strengths: UI development, Game development, Hardware Design

- Weiling Xi

  Full-time Master Student of RWTH Aachen, M.Sc Medien Informatik
  Part-time top-rated Freelancer with 100% job success rate

  Strengths: Computer Vision, Deep Learning, Machine Learning

- We As a Team
  From 2017 to 2020, we have a lot of experience working together and quite successful corporations, usually prototyping at hackathons with short development cycles

## Mentor

Tim Grylewicz (primary email: timgrylewicz@gmail.com )

Manager of Digitization of XERVON Instandhaltung GmbH

## Other Support

this project will get support on the artificial intelligence aspect from Alexandr Honchar (Chief AI Officer of Neurons Lab)

# *Mentor's statement on the feasibility and relevance of the project*

The implementation of a medical image analysis system (openTMAS) based on artificial intelligence and OpenSource has the goal to support medical experts in a sustainable way. The use of artificial intelligence and neural networks has reached a technological maturity level that allows the development and evaluation of digital assistance systems, even in small teams, with great economic benefits. From a technical point of view, the necessary frameworks and programming languages are freely accessible and also enable the necessary scalability.

The exchange of anonymized data, of imaging procedures such as CTs and X-rays is provided by freely accessible data sets (OpenData). Feasibility is also ensured by narrowing the scope of the project, with the team focusing on certain organs and specific training and evaluating the algorithm.

The team's skills include areas relevant to the project such as computer vision, machine learning, deep learning, user interface design and experience in rapid prototyping, which has been successfully demonstrated in various hackathons. Both participants are a well-practiced team and complement each other in their skills.

With a duration of three months, the team has enough time to identify requirements from interviews, to select and evaluate suitable machine learning algorithms and to create a first prototype with existing datasets, which is tested and iterative improved by key users. In order to ensure feasibility, the project scope is limited accordingly.

Thus the core functionalities are to be ensured and an adaptable application is to be developed under consideration of the scalability. There is a risk in the data bases, which has led to wrong assumptions (bias) in comparable projects. For this reason, the transparency of the data basis and algorithm must be guaranteed.

Medical experts have already been interviewed during a hackathon and the practical added value in the form of increased objectivity through AI, additional availability of parameters and the high potential time savings have been confirmed.

The strong practical relevance, the positive feedback of the medical experts and the first proof of concept motivates the team to push this project further. A transparent, data privacy-compatible OpenSource solution can support the medical experts in a meaningful way and thus ensure a positive change in medical image analysis.

Tim Grylewicz | Manager of Digitization of XERVON Instandhaltung GmbH