Computer Science Department Computing and Software Technologies Concentration

Final Year Project: Progress Report I

**Development of a Web-based Application**

**for CT Image Lesion Detection**

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1. Introduction

1.1. Background

Computer tomography is a method of layer-by-layer scanning of the area under study using x-rays. It is based on the fact that body tissues of different density weaken the rays to different degrees. After passing through the tissues, the radiation is detected by sensors and transmitted to a computer, where the signals are converted into an image.

A CT scan produces clearer images than conventional x-rays, especially if the examination is performed with contrast. Layered scanning allows you to identify and evaluate the size and structure of any tissue changes. For example, CT with contrast can distinguish a cancerous tumor from a benign neoplasm without a biopsy.

Computer tomography (CT) is especially informative in oncology. Layered scanning allows you to detect tumors at an early stage and start treatment in a timely manner. In modern tomographs, the “step” of scanning is so small that neoplasms with a diameter of only a few millimeters are detected. CT in cancer is performed not only for diagnosis, but also to evaluate the effectiveness of treatment, search for metastases. Sometimes under the control of CT, a biopsy of neoplasms is performed. Some of the advantages of CT images including, but not limited to:

* non-invasive and absolutely painless examination
* high accuracy
* the ability to obtain a three-dimensional image
* the image is stored in the computer's memory
* low doses of x-rays are used, so the method is considered safe.

Machine learning algorithms allow you to change the approach to the use of computer tomography:

1. Improved safety of the method. Artificial intelligence increases the value of a diagnostic procedure by allowing more information to be extracted from the acquired images. If necessary, the doctor can reconstruct the image from several sections and improve its quality by processing and filtering. There is no need to repeat CT. Computational processing partially replaces contrast agents, facilitating the visualization of pathological areas. The study can be carried out at lower doses of radiation and load with contrast
2. Detect subtle pathologies. ML algorithms perform image segmentation with the selection of areas of interest. Identification of small findings characteristic of the initial stage of the disease is an important component of early diagnosis.
3. Reduce image interpretation time. AI is able to automate routine processes: assess the extent of the lesion, draw up a preliminary report, and provide a quick exchange of information between doctors. If sorted, radiologist can prioritize severe cases
4. Rational use of hospital resources. With the help of a useful software tool that integrates AI based CT image processing, clinicians and radiologists can focus on only human-doable tasks.

1.2. Objectives

This project aims to help different target user groups:

1) Clinicians

2) Radiologists

3) Students and teachers

The web platform with an integrated AI algorithm will help the process of CT image processing become faster and more structures. Radiologists and clinicians will be able to upload CT image volumes on the web platform and get useful results displayed in a user-friendly manner, including the ranges in an image of potential tumour in the lungs of the patient and visualized description of the tumour.

For teachers and students, the system will be helpful to learn about diagnostics based on CT images with real clinical cases. Developing the project as a web application is an advantage, as it will be interactive and visually readable.

Moreover, the application aims to be flexible, so that it can run with different algorithms, depending on which one gives more accuracy.

Another objective of this project is to collaborate as a team with the research student, exchange our experiences in commercial web applications development and research & AI algorithm development.

2. Proposed system solution

The previously proposed system was based on an idea that the input data of the web application are clinical lab parameters. Therefore, the main change to the current system solution is basing the input data on digital CT image volumes. When it comes to the technical side of the project, we will stick to the following stack for the application:

1. Back-End development: MongoDB + NodeJS
2. Front-End development: JavaScript (Vue.js)
3. UI/UX Design: Figma

The ML algorithm is developed in cooperation with another student and is directly implemented to the web application via API calls.

The web application’s proposed main functions are including, but not limited to:

1. Authentication
2. Upload of the CT Image volumes
3. Automatic CT Image processing
4. Output results displaying (including visuals and informative description)

3. Proposed schedule

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| Step | Tasks | Dates |
| 1. Planning | 1. Finalize project objectives  2. Determine stakeholders and end-users of the application  2. Determine the boundaries of the project | August 2022 – September 2022 |
| 2. Requirements | 1. Research end-users’ needs  2. Figure out the functions of the app | September 2022 |
| 3. Design & prototyping | 1. Create schemas and architecture of the application  2. Create the User Experience flow  3. Develop the User Interface design  4. Plan out the communication between AI algorithm and the web application  5. Define the measures to take to secure the web application | October 2022 |
| 4. Development | 1. Build the database of the application  2. Develop the client-side and communication with backend  3. Integrate the AI algorithm to the web application | November 2022 – January 2023 |
| 5. Testing | 1. White box and black box tests  2. Trial run of the application with project supervisor  3. Fixing the bugs & implement improvements based on the test results | February 2023 – March 2023 |
| 6. Deployment | Build production version of the web application and host it | April 2023 |

4. Current activities

The project (as of 23rd September 2022) is at the planning & gathering requirements stage. I am now

1. Researching existing solutions for reference
2. Gathering data about the background of radiologists’ job nature, as this project’s objective is to automate it
3. Listing the requirements of the project and determining if they are in the boundaries of given time & resources
4. Determining the limitations of the project to focus on the main functions that will be helpful and are feasible to be delivered in the time scope.