Initial Report- Delineating regions of interest in MRI/S prostate scans for cancer diagnosis

CM3203 – Single Semester Individual Project – 40 Credits

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Project Description

Prostate cancer is an extremely aggressive and common cancer. It is now the second most common type of cancer in men worldwide. Magnetic Resonance Imaging and Spectroscopy (MRI/S) is used to identify potential malignant (cancerous) lesions in the prostate. This has aided doctors to quickly identify cancerous lesions and is a very important factor of the decreasing death rates related to prostate cancer. An MRI scan will produce several images taken from various different angles over the region in question. These images are stored in a DICOM image, which is a standard for medical imaging and related data. The DICOM will contain several slices of a prostate scan performed by an MRI as well as relevant patient information. In the context of a prostate scan, it is often hard for radiologists to navigate through the scans and mark-up potentially cancerous areas.

The aim for this project is to enable radiologists to easily navigate through scans of the prostate and mark-up/identify potentially malignant lesions. To do this, I will create a desktop application, written in python, that will first convert the DICOM images into a lossless image format and display the images in a viewer for the radiologist to manipulate. The application will have different features that aid the radiologist such as annotation, zoom, the ability to see annotations in images taken from different angles. And the ability to save the marked-up version of the images, with some information about any areas that they believe to be potentially dangerous such as the coordinates of the lesion.

Aims and Objectives

Overall aims for the project

This project is aimed at delivering a system that will aid the diagnosis of prostate cancer. Therefore, overall, I am aiming to deliver an application that is fast, simple to use, intuitive, accurate and will help radiologists to perform their job in a more efficient manner. The application should have clearly visible area in which the scan will be displayed to the user. It should allow the radiologist to quickly navigate through stacks of images related to a single

patient. The application should also allow for annotation (such as placing a polygon around potentially malignant lesions). The application should allow for manipulation of the image for the user to take a closer look at different parts of the scan. Finally, after annotation, the application should allow the user to save any marked-up scans and relate them to the relevant patient information.

Additional aims

Depending on how soon I finish implementation in relation to the time specified in my plan, I would also like to implement a few additional features. The two main extra features I'd like to have are to be able to adjust the contrast of the image, which would allow a radiologist to better distinguish between different shades of greyscale. Another feature I would like to add in would be the ability for the application to communicate with a machine learning algorithm that will itself attempt to highlight potentially malignant lesions. This should then allow the radiologist to correct or acknowledge the areas that the artificial intelligence has highlighted.

Objectives

As previously mentioned, the main aim of this project will be to deliver an application that makes the overall process of identifying and annotating potentially malignant lesions on a patient's prostate scan easier and more efficient for radiologists. To do this, there will be different components to the application that it will need to be judged upon in order to achieve this goal. Meeting the following objectives, in my opinion, will mean that I have created and delivered an application for its intended purpose.

- The application should have functionality that will read in DICOM files and convert them to a lossless image format.
- The application should have a simple and intuitive UI.
    - The application should prioritise ease of use and efficiency over any sophisticated design. It should follow the basics of UX design principles and be usable by people with potentially very low IT literacy.
    - All tools within the application should be clearly labelled and obvious as to their purpose.
    - This UI should take into account that we will be dealing with multiple different images related to the same stack, so ease of navigation through this stack should also be prioritised.

- The application should allow a radiologist to delineate regions of interest.
    - A radiologist should be able to 'mark-up' any potentially dangerous tissue on a scan. They should be able to apply a polygon to any region that they believe may contain a malignant region, this should then be visible in all other scans that contain said region.
- The application should clearly display the prostate scan at the highest resolution available.
    - DICOM images are usually displayed on screens with resolutions specifically calibrated to show them. This is important as radiologists need to easily

distinguish between different shades of greyscale on the scan. The application will likely be on lower resolution displays, so I will need to ensure that the image is displayed at the highest possible resolution.

- The application should allow a radiologist to zoom in on certain areas of the scan and view it in more detail.
- The application should allow the radiologist to save images that they have annotated.
- The report should clearly demonstrate, in detail, the entire functionality of the application and any issues that I encountered during design and implementation.

Work Plan

4th February – 10th February

- During the first week, I will be refreshing my knowledge of python in order to begin implementing algorithm that will convert the DICOM image to a lossless image format.
- I will also begin implementation of the algorithm to convert DICOM images to a chosen lossless image format (this is to keep the initial resolution of the images).

11th February – 24th February

- Once the algorithm for image conversion is set up, I will begin to wireframe the UI for the application. This should be done by the 13th of February at the latest.
- I will then begin designing the UX for the application without any of the functionality that it needs. I have allocated myself a further 11 days to get the UI for the application up and running and will hope to have this in place by 24th of February.

25th February – 3rd March

- When I have the basic UI and prototype of the application, I will begin adding functionality to it. The first and most important bit of functionality I will want to have in place is the ability to display the images in the application as well as allow the user to navigate through the entire stack that will be converted from original DICOM file. This needs to be in place by the 3rd of march.
- Some extra functionality to be added to the application at this point.

4th March – 10th March

- The next crucial bit of functionality that the application needs to have is the ability to annotate the different images. I will spend the first half of this working week implementing the ability to add a polygon to potentially dangerous areas on the scan.
- The second half of this week will be spent implementing a method that will allow the user to save the annotated version of the image.
- At this point in implementation, I will organise a meeting with my supervisor to demonstrate the prototype of the application to them. This is because in my opinion, two major components of the application will have been met.

11th March – 31st March

- Here I will enter into the final stages of implementation for the application. During this period, the functionality that I wish to add is the ability to see any annotation in multiple images that contain the same areas. This is likely going to be one of the most difficult things to implement, so I have allocated a larger amount of time in order to do this.
- Any time I have left over in this period I will aim to implement any additional features that I have considered, such as contrast adjustment or the communication with a machine learning algorithm.

1st April – 7th April

- By now, all implementation of the application should be finished. I will then begin to test my application and fix any bugs that surface when testing, however I have taken bug fixes into consideration when allocating time during the implementation phase of the application.

8th April – 10th May

- I will organise one final demonstration with my supervisor at this point to identify any concerns that they have in order to finalise the project before the hand in date.
- Upon completion of the application and adequate testing, I will begin to write my Final Report. Throughout the process of implementation, I will ensure that I am taking notes and correctly documenting my work so that the process of writing this report is made easier. This report should completely document all aspects of my time spent implementing the application, as well as detailed explanation and reasoning for different aspects of the applications functionality.
- The report should at the latest be started by the 10th of April and be handed in on the 10th of May.