Interactive Web-Based Application for Prostate Annotation in MRI

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1. INTRODUCTION

Prostate cancer is the second most common cancer and the fifth leading cause of cancer death among men in the past year. Nevertheless, during the last decades the death rate has notably decreased mostly as a result of an early diagnosis and an improvement on the tools used to perform it. Traditionally in the study of this cancer, radiologists analyse different imaging modalities individually. In this way, we can find cases in which the observation of the tumour can be compromised by different aspects and may not be detected correctly. For this reason, our goal is to develop an accessible application for any medical centre or hospital, without the need for a complex software installation, to help diagnosing prostate cancer and to provide a solution for these limitations.

2. THEORETICAL FRAMEWORK

2.1. Prostate Anatomy

The prostate is a gland that surrounds the proximal urethra as it exits the bladder. The upper part of the prostate is called the base and the lower part the apex. An example of the anatomy of a prostate gland is shown in Figure 1. It is divided into four zones: peripheral zone (PZ), central zone (CZ), transition zone (TZ), and anterior fibromuscular stroma (AFS).

In terms of image annotation in prostate diagnosis, the most common zones are CZ, PZ, TZ and Tumor (Tum), in case it is presented.

Fig. 1. Zonal anatomy of the prostate gland [2]

2.2. Magnetic Resonance Imaging (MRI)

Magnetic Resonance Imaging (MRI) is a non-invasive imaging technology that produces three dimensional detailed anatomical images, used to investigate the anatomy and physiology of the body in both health and disease. MRI uses a strong magnetic field and radio frequency pulses to produce detailed pictures of organs, soft tissues, bones and other internal body structures.

Advances in MRI have shown an improved detection and characterization of prostate cancer by using a multiparametric approach, which combines anatomical and functional data. This multiparametric MRI evaluation includes three general components: high-resolution Anatomical Images (T2WI), Diffusion-Weighted imaging (DWI) and Perfusion-Weighted imaging (DCE).

An example of each imaging technique is depicted in Figure 2.

Fig. 2. Example of a T2WI, DWI and DCE prostate images, correspondingly

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2. PROSTATE ANNOTATION APPLICATION

ProstateAnnotation is a web-based application in order to manage medical imaging DICOM databases and to allow a complete analysis of a prostate study. The graphical interface showed in Figure 3 allows to compare regions of interest, such as central, peripheral, transition and tumor region at the same time in order to diagnose pathologies or lesions. Hence, three different MRI techniques will be used: T2WI, DWI and DCE.

The application is divided into three different functional parts. The first one (a) refers to the patient information retrieved from the DICOM file. It consists of a dropdown to choose a patient within the database and a table displaying the information.

Then, part (b) consists in the image visor. Three different MRI techniques are shown simultaneously. Below it, there is a selection of filters that can be applied to each image. Furthermore, at the bottom there are two buttons to move forward or backward within the series of images. In case of Perfusion Imaging, you can also find a dropdown to select between space.

The last part (c) refers to the annotation system, being the main functionality. In the dropdown you can choose the zone where the annotation is going to be made. Coordinates of the annotations are shown in the table and can be exported by clicking the "export" button. Finally, in the bottom part this exported annotations can be posteriorly loaded by simply clicking or dropping the file there.
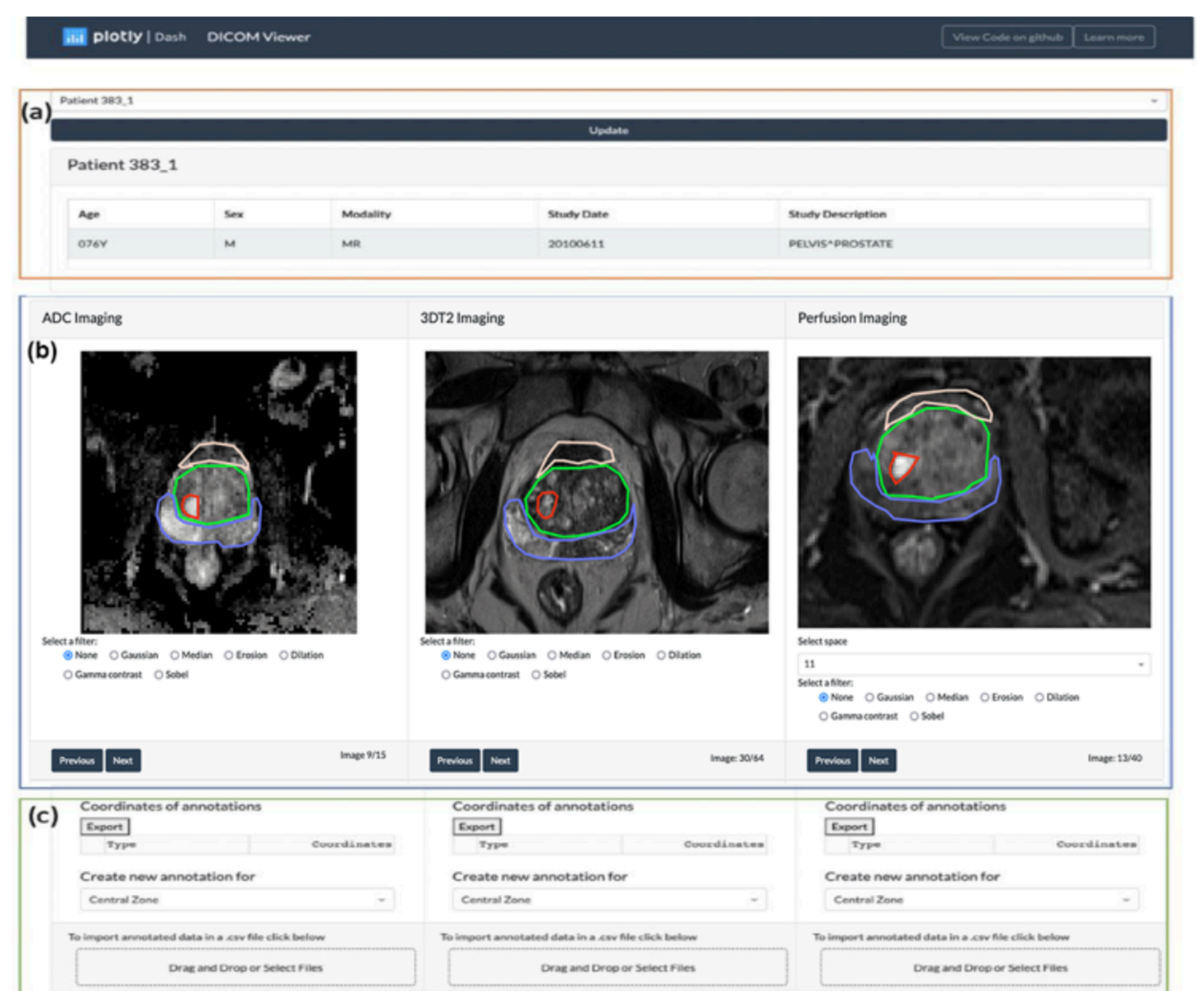

Fig. 3. Graphical Interface of the ProstateAnnotation Web-based Application

The application is uploaded to a Docker Hub where it can be downloaded and executed using a browser [3] and all the code can be downloaded from a GitHub repository [4].

3. CONCLUSIONS

- The developed application allows a simultaneous analysis of the same region of interest in different MRI techniques, providing experts a tool to annotate prostate findings in order to conduct a proper diagnosis.

- Moreover, it offers a direct access to DICOM files and its related information.

- As it is web-based, there is no need for complex installations or system requirements.

- This architecture can be easily adapted to other modalities and protocols, although being specialized in prostate images.