Bringing any Medical 3D Scan onto Augmented Reality Hardware - A Streamlined Data Pipeline

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SPIE. MEDICAL IMAGING

INTRODUCTION

This contribution presents a streamlined data pipeline to bring medical 3D scans onto Augmented Reality (AR) hardware. When a 3D scan is visualized on a 2D screen, depth information is lost, and doctors have to rely on their experience to map the displayed data to the patient. Showing such a scan in AR addresses this problem, as one can view that scan in real 3D. To achieve this, the scan produced by a medical scanner has to be preprocessed by the user and brought onto the AR hardware. Usually, many manual steps are involved in achieving this, which require technical knowledge about the underlying software and hardware components and impede acceptance of this new technology by the target group, medical personnel. This work presents a streamlined pipeline for this process, leading to an enhanced user experience. The core component of the pipeline is a web application, to which a user can upload the direct output of a medical scanner. The scan can be interactively segmented by the user, after which both the scan and segments are stored on a server. Additionally, this paper introduces an AR application, which can be used to browse through patients and view their scans and previously created segments. We evaluate our streamlined data pipeline and AR application in a user study, reporting the results of a system usability questionnaire and a Thinking Aloud test.
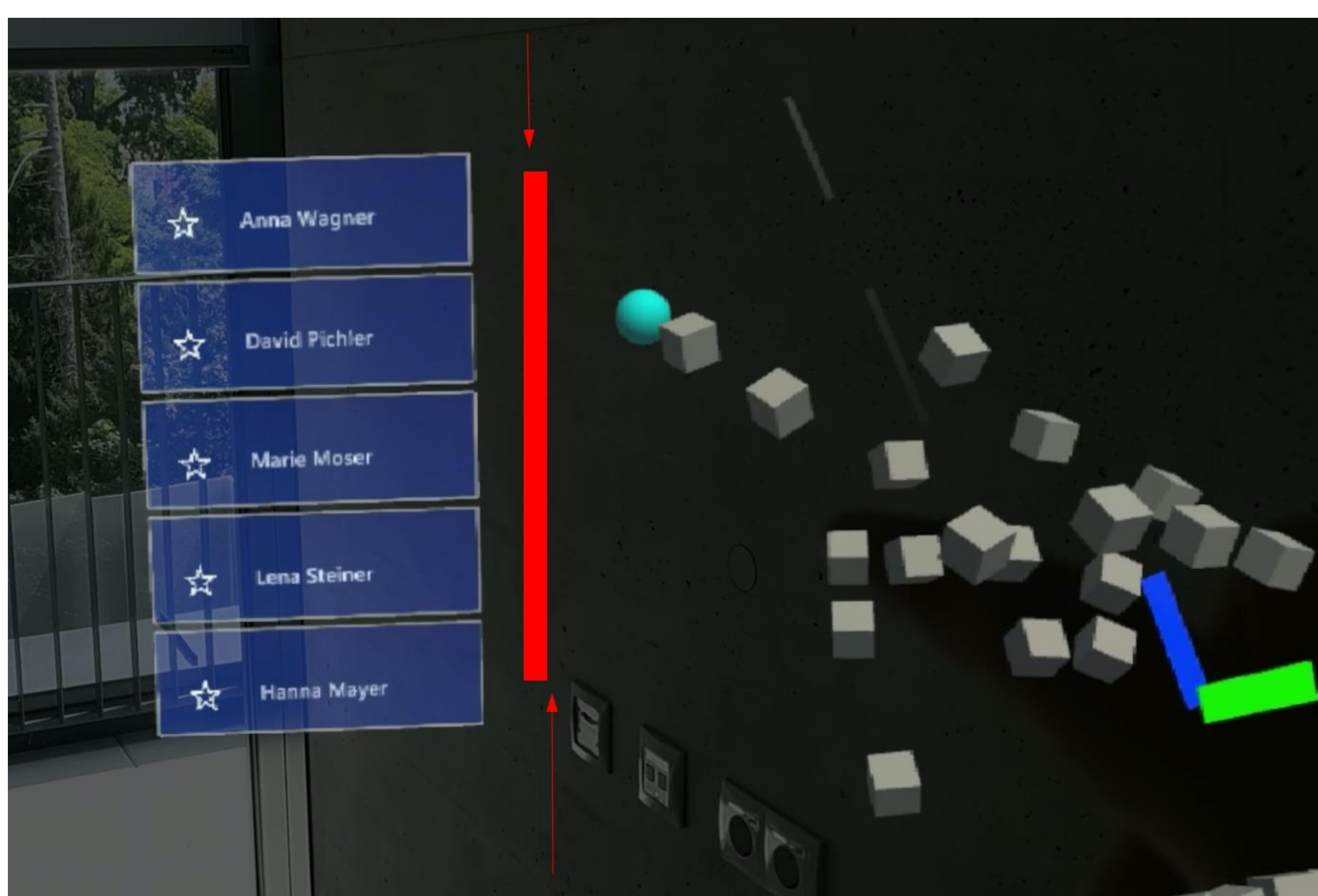

Fig. 1. Visualization of the patient list in the Augmentor AR App. Initially, only five out of ten patients are shown. The red arrows and the red bar indicate the position of a possible scrolling indicator.
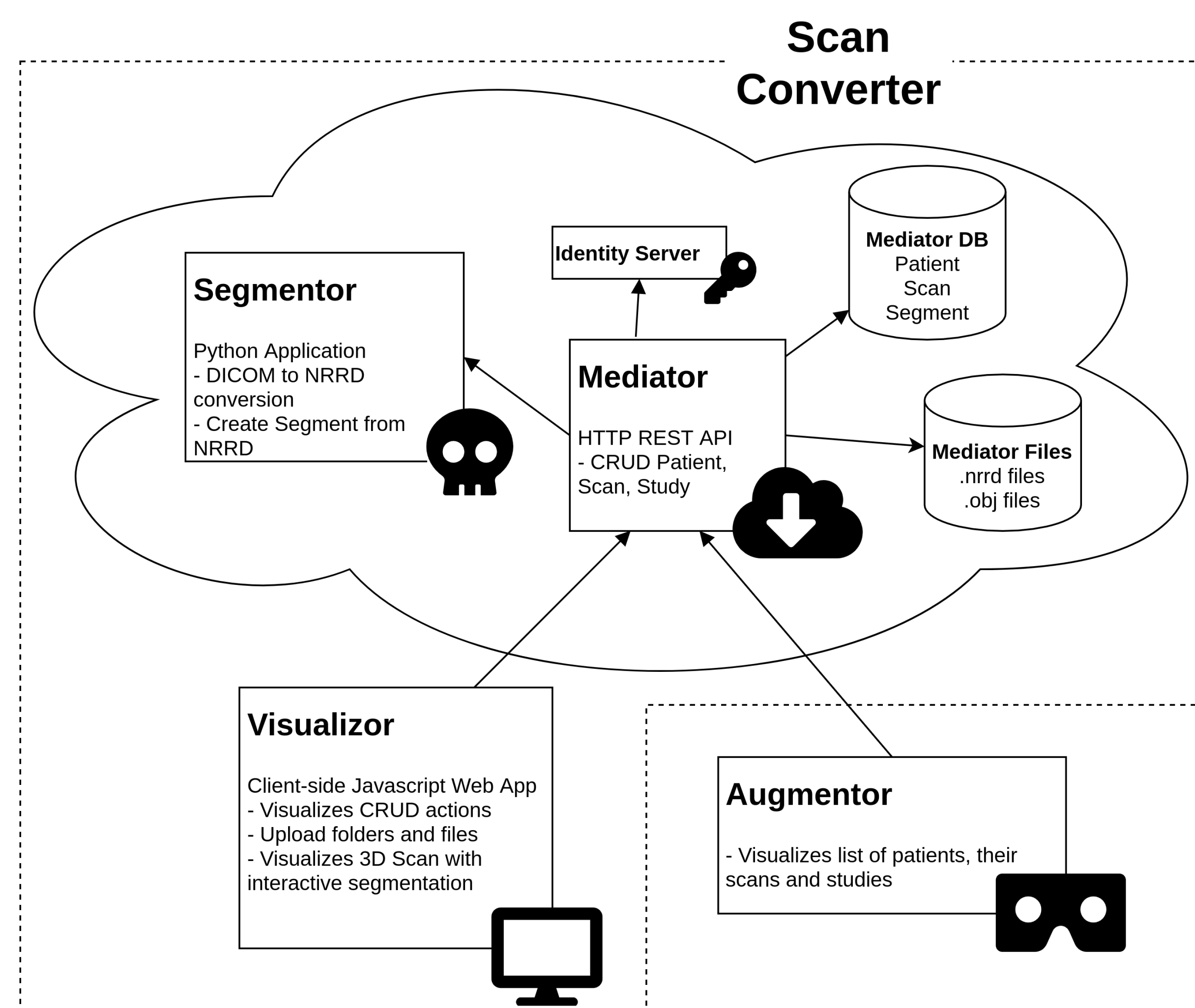
METHODS

Fig. 2. The architecture of the final application. Scan Converter is a web application, supporting the upload, conversion and segmentation of medical scans. Augmentor is an AR App running on the HoloLens 2, which is able to directly access and visualize the medical data managed by Scan Converter.

The implementation of our streamlined data pipeline is separated into four main services, combined with three storage units and an identity management service, which are shown in Fig. 2. The Visualizor is the entry point for the end user. It is a single page application and implements CRUD (create, read, update and delete) GUI functionality for patients, scans of patients and segments of scans. The Visualizor also handles the display of the 3D scan for interactive segmentation whilst creating / editing segments. As this is a purely web-based solution, files and data need to be saved separately to be used via another machine. This is where Mediator comes into play. As the name suggests, it is responsible for mediating the communication between all services. For all computer graphics-related tasks, it calls the Python script Segmentor. These tasks include the reading of DICOM folders and extracting .nrrd files, segmenting .nrrd files and creating 3D meshes. We call the combination of these services (Segmentor + Mediator + Visualizor) Scan Converter. Finally, Augmentor is the last link in the chain. The AR application, running on the HoloLens 2, visualizes a list of patients and their scans. Finally, after selecting a scan, the corresponding file is downloaded and visualized in AR.

RESULTS

As a method for user tests, Thinking Aloud was chosen with a subsequent System Usability Scale (SUS) form. Scan Converter achieved a SUS score of 62/100, while Augmentor achieved a similar value of 63/100. Fig. 3 & Fig. 4 visualize the results in detail. Fig. 1 shows one of the suggested usability improvements for Augmentor, namely a scrolling bar on the patient list.
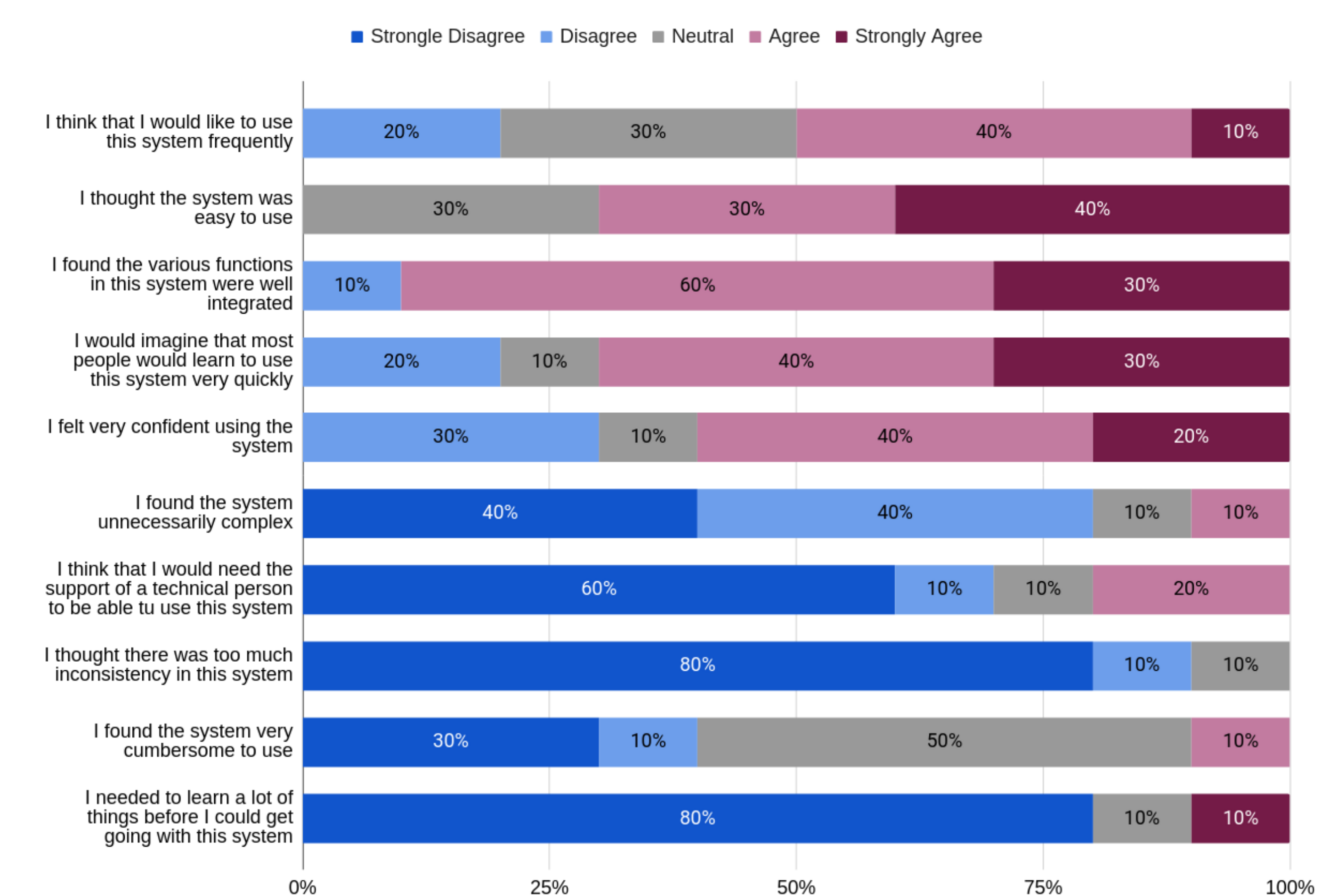

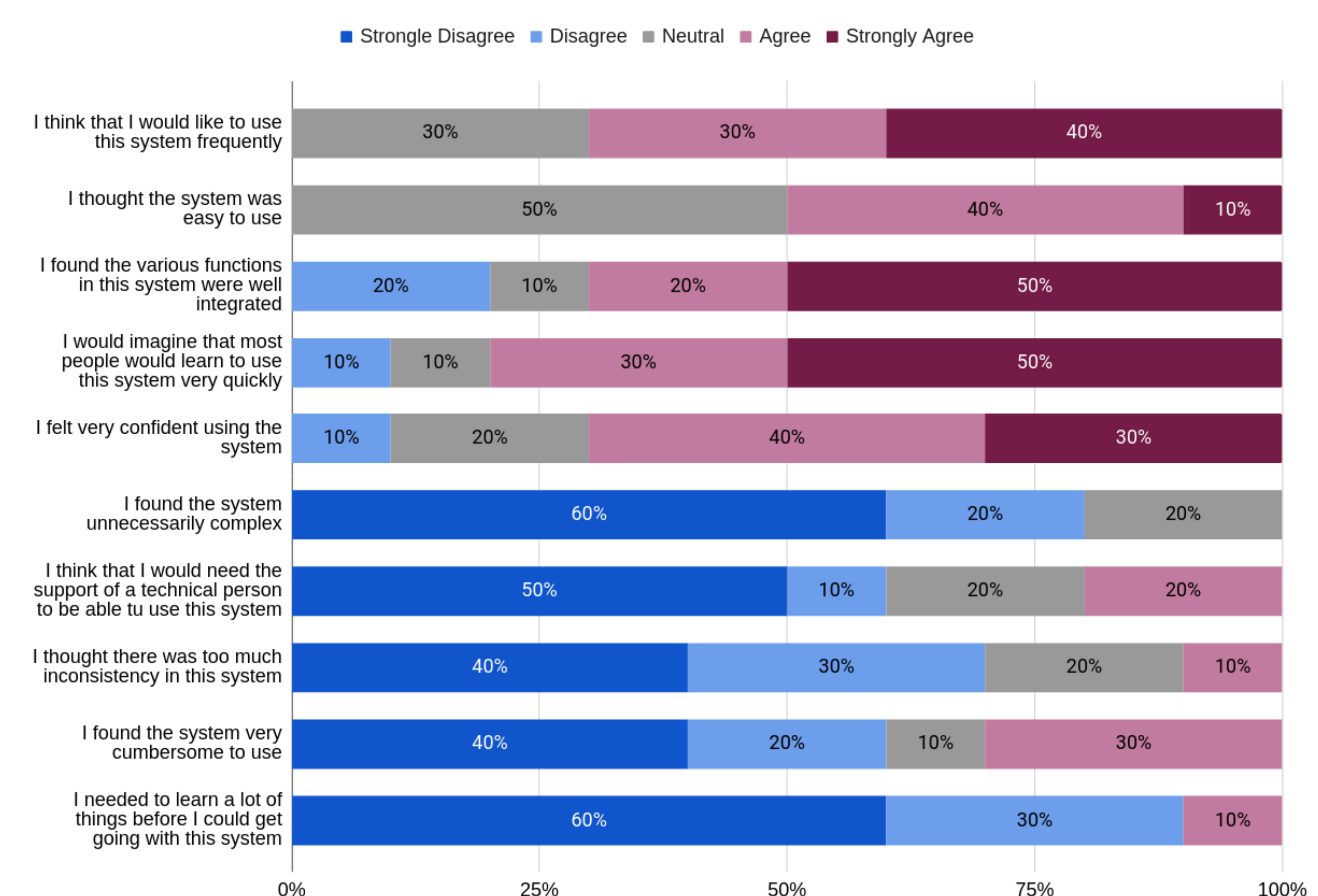
Fig. 3. The SUS results of Scan Converter.

Fig. 4. The SUS results of Augmentor.

REFERENCES

[1] Sauro, J., A Practical Guide to the System Usability Scale: Background, Benchmark & Best Practices, Measuring Usability LLC (2011).

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