

How long is your experience as a radiographer?

Five years of clinical experience as a radiographer and four years in education.

What impression did the wearing comfort of the HoloLens make on you?

As a wearer of glasses, I always found the HoloLens a bit uncomfortable, so I would be interested in the wearing comfort of the HoloLens 2. Regarding the wearing comfort for short sessions, I find the HoloLens comfortable to wear. Depending on how you plan to use it, you should check whether there is a loss of comfort when wearing it for 30 to 45 minutes. In the case of rental equipment, the wear and tear of the equipment and the resulting loss of wearing comfort should also be considered. The biggest limit in the use of the HoloLens 1 is certainly the Field of View (FOV).

How do you rate the visual quality of the HoloLens application?

The visual quality stands and falls with the recorded data, the higher the quality of the 3D scans, the higher the quality of the holograms. The image quality is very good, but the FOV is a scandal, for example if you want to have a short conversation with colleagues, lift your gaze and only see half of the hologram, that's annoying. In any case, the FOV is too small. A larger FOV is urgently needed, which the HoloLens 2 will hopefully provide. However, the resolution and image quality are enough in any case. The stability of the holograms is also good enough.

Do you feel that you successfully completed all the tasks on the task sheet?

Yes, I was able to complete all the tasks. The tasks could be performed without instructions. The application was self-explanatory.

What is your opinion on the applications menu?

The menu is straightforward, the small FOV is an issue again. If I raise my eyes and don't have the holograms in my field of view anymore, I might not see the effect of my action. For the audio output this is not an issue, but if I look up to enable the central beam, then look down to see it, it can cause visibility problems. Ideally every action would be in the same field of view. Otherwise the menu is well structured, clear and understandable. Thanks to the input of the focus group, all desired options are available. The functions of the HoloLens through the new developer toolkit are impressive. The audio feedback of the buttons is important to see if the inputs were accepted.

Could you easily undo or redo any action if you needed to?

I didn't have to undo anything. It wasn't necessary.

Were all menu items you expected present?

Yes

How do you feel about the methods of interaction with the holograms? Is the placement of holograms in the desired position and location intuitive or difficult?

Since I already have experience in using the HoloLens, I think that I find this a little easier than new users. The application is not difficult to use per se, but learning the gestures is important. Resizing holograms at the corners is self-explanatory. But for users who have not worked with the HoloLens much, it is important to learn how to perform these gestures. This could also lead to problems with the interaction of the holograms for new users. For me it was easy to handle and the holograms behaved as expected.

Would a short training for new users be helpful?

A basic HoloLens training course must be provided. Possibly by means of an instructional video about the HoloLens. I don't think that every student must practise operating the HoloLens with the hardware. This would be rather time consuming.

Any suggestions on how to improve the interaction methods?

Instead of enlarging or reducing the size of the hologram at the corners of the bounding box, it would be interesting to resize the hologram, similar to smartphone operation, by direct interaction with the hologram itself. But a manipulation of objects with bounding boxes is known from other programs like PowerPoint. If I insert an object there, I immediately know that the corners are for enlarging, the centers are for moving and a third field is for rotating. It would be more intuitive or easier if I could manipulate a hologram simply by using gestures like those of a smartphone.

Did the system provide enough feedback on your inputs?

A visual feedback, by changing the color of the corners of the bounding box, would be great. For example, if the selected corner changes from blue to orange

Would audio feedback to manipulation of the holograms be desirable?

I am not a fan of too much audio feedback. Regarding the menu I find the audio feedback a great confirmation if options have been selected. Due to the frequent manipulation of holograms, audio feedback would be an annoying feature here. As visual feedback, selected corners of the bounding box are displayed a little bit brighter, but this might be too little and too subtle for new users.

Did you have any issues with the application? Did you encounter any errors or crashes?

Nothing, no errors and nor crashes.

How was your impression of the application compared to other HoloLens applications?

I don't know if this is due to the application itself, or if HoloLens applications in general have evolved. My last use of a HoloLens application was two years ago. In comparison, the application is more pleasant to use, clearer and tidier.

How useful was the hologram to help the positioning of your test patients body part?

Resizing is useful for viewing details. It helps to visualize where anatomical structures are located for example. The visual aid of the hologram is also helpful for positioning the central beam.

Was the hologram transparent enough? Was the brightness adjustment of the HoloLens useful?

One must be careful not to work in a room that is too dark or too bright. Too bright surroundings with a lot of sunlight could be disturbing. I think half-dark rooms, as it is common in X-ray rooms, can lead to good results. I have not missed a regulation of the transparency of holograms in the application.

How easy or how hard was it to position a patient according to the hologram?

In the beginning it was a bit difficult due to too much brightness in the room. Basically, the placement of test persons in the hologram is easy due to the possibility to place holograms on surfaces. The hologram was stable enough to reliably assist in positioning.

Did the virtual light beam localizer help with the positioning of the real-life localizer?

Yes, the possibility to check the position of the central beam in advance is helpful. But I would see the benefit rather in preparatory exercises for the actual positioning. A fade-in button to display possible wrong positioning would be interesting.

Do you think AR applications can benefit the education of radiographers?

Yes. Procedures can be explained in detail. The structure of machines can be shown. Theoretically patient conversations can be simulated by AR. AR is suitable for teaching all types of content. Especially for patient interaction, such as in X-rays, AR has potential. The function of nuclear medical examinations could also be visualized by utilizing CT data sets. In radiotherapy, patient positioning at the linear accelerator could also be practiced. In addition to practical training, AR can also be used to visualize processes. For example, the positioning of magnetic coils in MRI.

Do you have any further comments or remarks?

Possible display of common incorrect positions of the central beam by additional coloured field lights.