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UCL Peach Group 39: Reality
Bi-weekly Report #3

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1 Overview of the last 2 weeks

The period since the last report was mostly spent on experimentation and attempts to implement various features mentioned in our requirements. We set the primary focus on gestures and user interaction, producing experiments which allowed users to rotate models in 3D space and adjust their colours. Additionally, we looked into controlling HoloLens using voice commands which turned out to be quite a feasible to interact with our application, as the user now longer has to hover over buttons using Gaze.

We've begun writing up the summaries of experiments on our team's static site on UCL CS servers, which is available here: http://students.cs.ucl.ac.uk/2016/group39/. There is also some content available in other sections, but we're still figuring out the best way to present some information so there is still content missing.

After the meeting with our client we refined some of the requirements and produced a MoSCoW analysis, since after some experimenting we were able to make an educated assessment of feasibility of various features. This assessment can be found on Figure 2 in the appendix of this document.

Due to the fact that we had a busy Scenario Week, during which we've all been divided into teams and given a challenge to complete, and that not everyone was available during reading week we didn't meet as often in person but we still kept active contact on Slack, sharing ideas and discussing progress. Below you can find the summary of meetings we held since the last report.

2 Summary of meetings held

2.1 Monday November 14$^{\text{th}}$, 2016

On this brief meeting we discussed the progress done over the previous 2 weeks, experiments that took place and what knowledge we've acquired, and the current design of our static site. While transferring the source code of the site to Blitz (more about it in section 6.1) we've significantly improved its appearance and the logical structure of all of its sections.

After having conducted several experiments and assessing the feasibility of various features, we compiled a list of problems we've encountered during the development to use it later during our research and further attempts to implement features as described in the specification of our application. Additionally, we begun shaping out the structure for the web app and the way it will interact with HoloLens, which was finalised on the next meeting.

2.2 Friday November 18$^{\text{th}}$, 2016

We spent this meeting demonstrating and discussing the conducted experiments with our TA and client, receiving some useful feedback in the process. One of the comments involved our current colour manipulation concept, which we might have to reconsider since, as pointed out by our client, members of our target audience would probably not be willing to spend enough time to preprocess the model before analysing it for colour

manipulation to be feasible. One of the possible remedies is to apply some standard colours to various parts of the model (such as arteries or tumours) before showing the model to the user.

It was also brought to our attention that we might have to present our prototype on the 5th of December, which forced as to readjust our development schedule considerably. You can see the Gantt chart for our plan of action until that date on Figure 1 in the appendix. Completing the first prototype by that date would mean progressing way faster than we initially planned, which gives us a lot of time to reiterate and improve our implentation.

During this meeting we've also produced a MoSCoW analysis of requirements we have established in the past after a discussion with our client, you can find the result on Figure 2 in the appendix.

3   Tasks completed

- Finalised the template for team's static site. The content production is underway and experiment summaries are put online as soon as said experiments are conducted.

- Established a template for future experiments

- Conducted experiments regarding user's interaction with the HoloLens, specifically manipulating a model in 3D space and changing colours of components.

- Refined project requirements, adding MoSCoW analysis and reconsidering priority of some requirements

- Produced user stories for user's interactions with the application

- Produced a concept of the web app that will expose an interface for users to import models and an API for HoloLens to retrieve said models.

Considering how successful our experiments have been so far, I would say we're definitely proceeding on schedule if not ahead of it.

4   Problems encountered

- HoloLens doesn't support standard Unity shaders, and native shaders that came with HoloToolkit don't always work as intended. This an issue we definitely have to focus on since colour manipulation is one of the primary features of our application.

- Although we decided to stick to the very basic predefined HoloLens commands and voice control, even these gestures and commands are not very reliable. We have to develop algorithms that will assist users in interaction with the app to help correct obvious mistakes of the users.

- Before making models available for HoloLens to download, we realised we have to preprocess them to make sure they are all roughly the same scale and colour coded where possible to move some processing load from HoloLens to our servers.

- We had to speed up our development process to have more features ready by 5th of December, which definitely posed a challenge so extensive planning will be required to maximise efficiency.

5   Plan for the next 2 weeks

- Design the UI for the web app and choose the framework to build the web app and API on.

- Refine various scripts produced during experimentation to extract their generic implementation, which would be easy to reuse in the prototype build.

- Implement a graphical user interface in the HoloLens application, including menus to import models into the scene and buttons that would appear over all active objects (e.g. rotation, translation, colour controls, etc).

- Develop the first prototype of the web app, that would at least allow users to register, upload models into the system and expose an API that HoloLens would use to retrieve information and download models.

- Produce a prototype of the HoloLens app that would support importing models uploaded through the web API, and manipulations such as rotation, translation, scaling and colour change, as well as a feature to view multiple models at the same time.

6   Individual reports

6.1   Timur Kuzhagaliyev

I spent the last couple of weeks diving into HoloLens development with Unity, studying thoroughly example source code provided by Microsoft HoloLens and conducting experiments related to voice commands, dynamically loading models into Unity runtime on HoloLens, calculating bounding boxes for models based on their meshes, manipulating colour and transparency of models using gestures and accessing APIs over internet. Demonstration of one of such experiments can be found here. Additionally, I believe I've become familiar enough with specific features of C# and Unity to begin writing maintainable code, so I begun producing short C# classes which we can reuse in future prototypes/experiments.

I've spent some time improving the appearance of the static site with the development log for our project, and after experiencing the frustration of having to deal with existing static site generators, I've developed my own solution available at https://getblitz.io/ (documentation to be produced). Since I'm responsible for the production of documentation, I've also been filling various sections of the website with relevant information.

I've also managed to get permission to take HoloLens home and experiment using the actual device as opposed to using the emulator, which allowed me to understand the limitations of the device better and see how feasible various gestures are in reality. One of the things I noticed was that the end of the manipulation gesture (achieved by pointing your index finger upwards, the folding in and moving your fist around) is not always properly recognised, so to ensure that the gesture works correctly the user must open their fist to tell HoloLens to stop tracking the manipulation. I am still thinking about possible programmatic solution to this.

6.2   Fraser Savage

During these three weeks since the previous report the majority of my work has been on tasks within the "Experiments" epic. The core task I completed was to experiment with user interaction in the context of hologram rotation and produce a basic demo of such interaction.

As part of this task I also incorporated the Microsoft HoloToolkit-Unity repository resources into the demo, while assessing the advantages of having them available. The key components of the HoloToolkit which I most took advantage of were those relating to the "Gaze" functionality and the associated cursor, with the transition between a no object focused cursor and an object focused cursor already in place. The current rotation interaction works through offering rotation through Yaw and Pitch motion, although the Pitch motion needs more refinement.

While working on these tasks I have begun formulating a Unity project template for future experiments, which includes the Unity HoloToolkit. This template might potentially be stored in it's own branch of the repository so that if a developer wishes to create a new experiment they just checkout a new branch from the template branch and can start experimentation straight away.

6.3   Laura Foody

This week I have been focusing on learning how to use Unity for HoloLens by working through their tutorials. I was having some issues because it turns out I didn't have the camera but our TA helped me to find it so I

will be able to go back over the work I've done and put the camera in those as well. Alongside doing the Unity tutorials I have been doing the code academy C# tutorials but I have found them to be quite slow and so on the TA's recommendation I will use stack overflow and search for specific things I want to learn. I also wrote up the user stories using the requirements on the Google Drive.

In the next week I will be focusing on creating the front end for our web interface which will allow users to import models and DICOM images which will then be processed so that they can be used on the HoloLens.
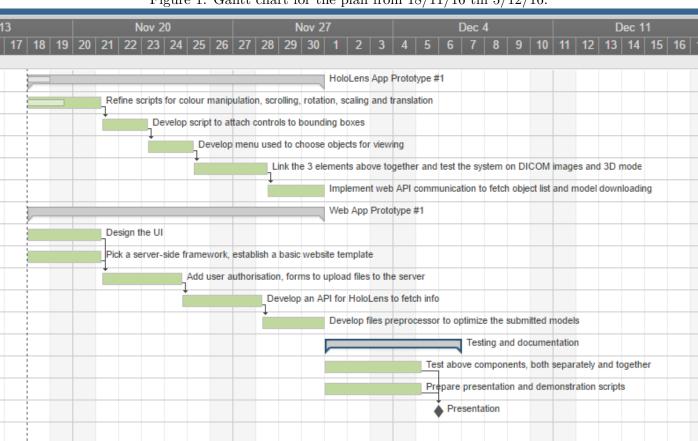
7 Appendix

Figure 1: Gantt chart for the plan from 18/11/16 till 5/12/16.

Figure 2: MoSCoW analysis of application's features.

	Must have	Should have	Could have	Won't have
Web app:	Feature to upload models to be viewed on HoloLens	Feature to pick the colour of components for the model using a colour picker, before the model is uploaded to HoloLens	Feature to convert DICOM images into 3D models	
	Feature to upload DICOM images to be viewed on HoloLens			
	Feature to delete models/DICOM images from the system			
	Feature to toggle which files are available (visible in file list) on HoloLens without deleting them	Feature to preprocess models before saving them, making the model preparation process easier for the user		
	Web API to be used by HoloLens to download data			
HoloLens app:	Feature to select previously uploaded files for viewing	Feature to view patient data (pulse, blood pressure, etc.) in real time	Feature to produce 3D visualisations of big data	
	Feature to view multiple files at the same time	Feature to switch between poster view and heads-up display for real time data	Feature to share models/DICOM betwee several HoloLens devices	
	Feature to rotate, scale and move models/DICOM	Feature to save colour information so that model has the same colours next time it is loaded		
	Feature to expand models and change colours of components	Feature to manage models currently downloaded to HoloLens		
	Feature to view files that were previously downloaded and saved to the device			
	Feature to scroll through single or multiple DICOM images at the same time			

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