

UCL Peach Group 39: Reality

Bi-weekly Report #7

Timur Kuzhagaliyev
Fraser Savage
Laura Foody

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1 Overview of the last 2 weeks

Over the last 2 weeks we held a number of meetings on 03/02, 07/02 and 10/02. Below you can find the list of topics discussed and decisions made during said meetings, as well as the overview of the progress made by our team.

- The renal surgeon meeting mentioned in the last bi-weekly report was moved to the 22nd of February, which gives us more time to tailor questions to the audience and prepare a new prototype of the HoloLens application.
- We held several meetings with Dr. Shabnam Parkar and the team of first years she is supervising (Immanuel, Yvette and Justin). Their project is seemingly identical to ours, except the focus will be on thoracic surgery in children. This fact gives us a lot of room for collaboration, and considering that they only have a couple of months to work on this it will be mutually beneficial for us to delegate development of less complex parts of our application to them.
- We spoke to Lorenz Berger about the capabilities of his neural network in relation to the chest area. He informed us that he's already performed some tests on lung nodules and in theory it should be possible to use his solution to generate models of both kidneys and lungs.
- We'll be producing a short paper to document our progress so far and the results of our project, namely the seamless pipeline concept (CT scans to 3D models) and the upcoming Holographic Patient Case file format.
- We defined specifications for a Holographic Patient Case and User Representation within our system, which allowed us to begin developing interfaces and relevant features for each part of the application separately, since we can now assume the other parts will comply with the specification.
- After a discussion with our client we agreed to choose Apache 2 License for all of our code. It's an open source license that allows redistribution, adjustment and commercial use of derivations of our code, given that the original notice with our contact details is provided with every copy.
- Most of the HoloLens Model Viewer code has been refactored, which drastically decreased code duplication and improved overall architecture of the app. Most of the components are now completely decoupled which will make it easier for future developers to extend the project.
- A formal API specification is now hosted on our main Azure server, which should make it easier for other developers to integrate Holographic Patient Cases into their systems as our API can handle all of the business logic related to them.

2 Tasks completed

- Met Dr. Shabnam Parkar and a team of first years working on a HoloLens project similar ours
- Begun negotiations about collaboration with said team, particularly in web app development
- Defined User Representation in our system and integrated it into the API
- Defined Holographic Patient Case
- Documented existing API endpoints hence establishing formal API specification, which is now hosted on our Azure server
- Studied patent and license option available to us, and chose Apache 2 License as the license for all code in our system per suggestion of our client
- Improved user experience and performance of HoloLens application

We've done a decent amount of work in the last 2 weeks and completed most of the planning exercises, hence making a good start at development. The project is progressing as expected, and we're planning to deliver new prototypes for different parts of our application before the next bi-weekly report is due.

3 Problems encountered

- Considering that there another team in the computer science department working on an identical HoloLens project, it might be a good idea to make them a part of PEACH and start collaborating. Given we'll be able to convince them, which presents a challenge of its own, we'll have to reallocate the roles within our team taking new team members into account.
- Applying photorealistic textures to 3D models in the HoloLens application proved to be challenging as we expect the models to be "crudely" generated from CT scans and loaded into the HoloLens app without any preprocessing. Due to this we have to dynamically map textures to models to make sure they are displayed correctly and the results so far have been unsatisfactory.

4 Plans for the next 2 weeks

- Write a file format specification based on the establish Holographic Patient Case specification
- Write a short white paper documenting our progress and results so far
- Agree on the extent of collaboration (if any) with the first year team
- Complete the third prototype of HoloLens model viewer by adding such as button tooltips, fluid animations and user authorisation
- Add automatic deployment to Azure server to our current API continuous integration pipeline
- Setup API endpoints to server holographic patient case data as described in the Holographic Patient Case specification on Google Drive
- Add authorisation and basic functionality to the web app prototype
- Prepare questions and demos for the urinal surgeon meeting on the 22nd of February

5 Individual reports

5.1 Timur Kuzhagaliyev

I've recently been assigned as a supervisor to a team of first year students working on a HoloLens project similar to Peach Reality. I've held several meetings with them, some in the presence of their client, Dr. Shabnam Parkar, where I could help them gather requirements, gave them links and general advice about HoloLens/Unity development, and suggested how they can proceed about their project. I've also discussed potential collaboration opportunities with them, and I believe they are likely to agree given Dr. Parkar give us her permission.

Additionally, in the last 2 weeks I've spent a lot of time writing specifications for various aspects of our application, including user representation and holographic patient case. I tried to eliminate all ambiguities and make sure to convey my vision of said concepts as clearly and coherently as possible, but said specifications are still vague in some places which I'm planning to improve as we'll be adding new features to our application.

Finally, I've refactored most of the C# code of our HoloLens application. Since this was the third iteration of the model viewer, I had a chance to look through the existing code extracting common components, eliminating code duplication and decoupling various parts to make them easier to reuse. I'm not done with this process yet but the overall architecture of the application has improved significantly and it is now much easier to follow the logic in the code, which will hopefully aid future Peach Reality developers.

5.2 Fraser Savage

During the sprint just past, I achieved the main goals which were set out at the start of the sprint, while also making progress on a task added to the sprint half way through. Work on implementing the necessary features in the final proof of concept has begun in earnest now, making use of the specifications for both User Representation and Holographic Patient Cases as they are laid out on the Google Drive shared folder.

The first goal attained in the sprint was to add support for users as described in the User Representation Specification. Users are able to be persisted in the database and a set of basic operations are in place to enable setting the value of parameters such as Email, Name, Organisation and so on. Additionally, user authentication was implemented in tandem with the User Representation Model, with passwords only stored encrypted (with the salt) using the algorithm "PBKDF2WithHmacSHA512".

The second goal attained was to integrate the API documentation into the CI process. I have achieved this through taking Swagger UI, an open source visual documentation representation for Swagger based APIs, and serving the distribution bundled into the API under the /docs/ endpoint from the context root. This means that as work is performed and features added the docs are automatically built and served with the deployed API, provided that the features are annotated in the code (which they are under our process). This allows both Tim and Laura to have access to up-to-date docs throughout the development process.

Past these goals, I have begun to work on representing Holographic Patient Cases in the API and providing ways to work with them through it, while also starting to extend the API to provide more ways to utilise the User Representation Model. This is what I plan on doing during the next sprint, in addition to looking into test coverage reports, automatic redeployment and making use of Azure's blob storage for Holographic Patient Case files.

5.3 Laura Foody

This week I have been continuing to work on the user authentication. I tried to use the auth0 library that I had used in experiments in the first term however you have to use Auth0's middleware which is not part of our specification (and something I was keen to avoid). I then started trialling the react-form dependency but found it to be ugly and so started looking at other libraries available on npm that would enable me to build a form. I found material-ui and through that I found an excellent tutorial helping you to build a login/signup form using JWT authentication.

I followed the tutorial and at first tried to keep the webpack configuration I had previously but instead followed the tutorial's recommendation to use nodemon. So far I have built the form structure using material-

ui and have finished the full tutorial but I have encountered an issue with Mongo so haven't yet got the authentication to work. I will then need to integrate it with the back end that Fraser has created; as there will be some cross over with backend/middleware between his server and APIs and the frontend I have built using the tutorial.