Project Plan

Project Name: Mixed Reality System

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Issue Date: 20/9/2016

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I. Summary

Mixed Reality is a pioneer technology which just hit the world this year. Although the idea itself has been mentioned in many academic or entertainment platforms for over a decade, the technology was just realised in the middle of 2016. Both Google and Microsoft released devices for Mixed Reality development this year.

Different from Virtual Reality and Augmented Reality, users in Mixed Reality are able to perform physical interactions with the digital world in real time. Both the virtual world and the physical world is mixed together to form a new reality.

We decided to further explore Mixed Reality and leave Virtual Reality and Augmented Reality behind. We want to develop a game like application, while also regarding the project as a research on this technology. We see there is great potential in Mixed Reality, which can make unbelievable impact on Education, Surgery training, Computer gaming and any industries involving Design. The details of all these 3 concepts will be explained in the Background section.

1. Background

Before introducing the concept of Mixed Reality, some clarifications need to be made on Augmented Reality and Virtual Reality since they can easily be confused with Mixed Reality.

In Virtual Reality, A head-mounted device covering the user’s sight and hearing is used to transmit high definition 3d computer graphics and audio. Users can therefore immerse themselves in the digital world as if they were actually in reality. The digital world generated can also be based on a real environment. For example, user can enjoy the view of the Grand Canyon while sitting at home.

Augmented Reality is the mix of both digital and physical world. The digital data is overlaid on the physical world to create the illusion that both aspects are in the same reality. This usually appears on smartphones or windows. For example, map instructions or information can be projected on the dashboard of a vehicle to guide the driver. Popular games such as Ingress or Pokemon GO also uses Augmented Reality.

Mixed Reality is rather similar to Augmented Reality. Both digital and physical data are mixed together to form a new reality. However, digital and physical objects would have physical interactions in real time to even enhance the illusion of having both aspects in a same reality. As an example, if you throw a digital ball to a physical wall, the digital ball should be able collide with the wall and bounce back.
2. Objective

The aim of this project is to develop a mixed reality system, collaborating with 2 different mixed reality devices, a headset and a tablet. Users can summon virtual blocks with different colours to build structures just like playing with lego blocks. They can manipulate the virtual blocks by either finger movements on tablet or hand gestures when wearing the headset. The reason we want to put 2 devices together is to let people without a headset to also participate in the game.

II. Theoretical Background

In the following, we are going to introduce the theoretical background of this topic by introducing some studies and reviews.

This idea of Mixed Reality has actually been explored by Japanese researchers as early as 2000. Mixed Reality aims at offering similar immersive experience on a hybrid of virtual and real world, unlike Virtual Reality which provide such experience by separating users from the real world, thus real time response, space and graphical quality are crucial [1]. As we know by that time, 3D graphics technology was far from being mature, and it only acquired great improvement in recent years. Some projects were to explore Mixed Reality by them: Big screen surrounding people to show cityscape and wearing a see-through HMD (Head Mounted Device) [1], namely a headset allow user to see the real world, a glasses like device, the computer graphic should be generated on the lenses. This approach can provide better experience to user [1]. We guess the idea of Google glass was not actually from Google itself, as apparently there are pioneers in another side of the earth, but they were blocked by the computing power and computer graphic.

In 2005, another research leading by a team from computer science at the University of Central Florida started to discuss the importance of Mixed Reality on Education, Entertainment and training. The most attractive features are the stunning visual effects and the simulation of objects or environment that cannot be realised repeatedly and easily [2].

The design and practical usage of Mixed Reality has once again be discussed by a professor from computer science and a professor from intermedia in their book. The aim is the same as that of the Japanese research [3]. To perform complex computation on space, time and interaction, the Mixed Reality can provide the illusion of integrating of physical and virtual space [3]. One of the conclusion from them is that this technology can open a new era on creative and cultural industries, architecture and medicine [3], exactly like the future of this technology we have discussed above.
III. Pre-requisites

1. Mixed reality devices for the project such as Google Tango and Microsoft HoloLens are provided by the Department of Computer Science.

2. The project would be done on the Unity which is a multi platform Game Development tool with its own Game Engine. Unity also has sdk provided for both Google Tango and Microsoft HoloLens. The programming language for Unity is C# and Javascript.

3. We have good reason to use Unity3D as an editing platform, not only because our project will be a game, also because we need software development kit provided (SDK) from Google Tango and Microsoft Hololens, and their SDKs has just been well cooperated with Unity3D, we can simply download the SDKs from their official website and directly import into Unity3D to use. Apart from these, we also need Photon Unity3D Networking Framework SDK to realise our multiplayer feature. They are all written in the same programming languages that Unity3D require developer to know, no extra programming language is needed.

IV. Approach & Methodology

Google Tango SDK
Microsoft Hololens SDK
Unity
Photon Unity Networking Framework SDK
They are the software components we need for development.

One of the 2 objectives is to collaborate the 2 devices, But they are quite different. Before combining 2 devices to work together, we need to study their individual behaviours first.

Jack and SHI SHENG are responsible for the exploring of Microsoft HoloLens.
Jerry and Garry are responsible for the exploring of Google Tango.
The study on 2 devices can be parallel, and thus more efficient.

First, we are going to play the provided demos on the devices to understand more of their actual features and capabilities. This is important in helping us to decide whether any new ideas are feasible to the project. After that, we will start studying the SDKs and related documentations. We know that all of the above SDKs are available to use by simply importing them into Unity editor. During the learning process, we will take a look at the structure of the SDKs, so that we know which source file should be modified and which one may cause trouble upon modifying.
After developing simple test prototype for individual devices to work successfully. Next step we will try to make prototypes communicate on the 2 devices through networking. At this point, we will work on the Photon Networking SDK. We can modify the client side of SDK to let demos communicate through own hosting Photon server software. After prototype successfully done, we will start to refine the parameters, details and user interface, and finally to present the final product.

V. Feasibility

1. Mixed reality devices: Google Tango & Microsoft Hololens \(\cdots\) \(\textit{Purchased}\)
2. Unity3D Game Engine \(\cdots\) \(\textit{Available For Free Download}\)
3. Google Tango & Microsoft Hololens SDKs \(\cdots\) \(\textit{Available For Free Download}\)
4. Networking Component: Photon Unity3D Networking Framework SDK \(\cdots\) \(\textit{Available For Free Download}\)
5. Programming language: C# \(\cdots\) \(\textit{Easy to learn}\)

For Google Tango, there are already a series of demo applications available in Google Play, and are specifically recommended by Google as a promotion of Project Tango. Some of the applications are written in Unity, as evidenced by the Unity splash screen at the startup. One of the applications among the list is called “Solar Simulator” by Angstrom Tech. This application allows users to locate the solar system in the “real” world with a diminished scale [4], which is very similar to our goal in the aspect of the controls. As evidenced by these applications, this project plan is theoretically feasible.

VI. Project Management

<table>
<thead>
<tr>
<th>Scheduled Time of Completion</th>
<th>Task</th>
<th>Jack</th>
<th>Shi Sheng</th>
<th>Jerry</th>
<th>Garry</th>
</tr>
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<tbody>
<tr>
<td>October</td>
<td>Researched on Tango feasibility</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>Researched on Hololens feasibility</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
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<tr>
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<td>Determined the project goal</td>
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<td>✓</td>
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<td>Tango singleplayer development</td>
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<td>✓</td>
<td>✓</td>
<td></td>
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<tr>
<td></td>
<td>Hololens singleplayer development</td>
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<tr>
<td>December - February/March</td>
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<tr>
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<td>Optimization and testing</td>
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</table>
VII. Risks & Challenges

Since Mixed Reality is a new technology, all the provided SDKs and documentation would be rather vague. We would encounter a lot of technical problems and finding solutions online wouldn’t be as easy as usual. The constant updating of software might also force us to modify our work. For example, features that we use might suddenly be modified, replaced or even disabled. Moreover, new versions of SDKs usually contain few bugs that might cause trouble.

Other than technical difficulties, division of work would also be a challenge since our project has a lot of coding work. Coding is easier when working alone and it is almost guaranteed that we would encounter multiple bugs or errors while merging codes from different group members.

VIII. Scope & Deliverables

In the first stage (October 2), a detailed project plan and a website describing our project, including the background, goal, methodology and schedule, will be ready.

We are going to develop a complete game without complicated system, because the focuses of the project are to present the specialty of mixing virtual and real worlds, to collaborate the 2 devices mentioned above to realise the goal, Google Tango and Microsoft Hololens, and to build multiplayer interaction to enhance user experience on our game. What players can manipulate and control are a variety of virtual blocks and other more sophisticated objects like furnitures or city models or human models. Therefore the game will not consist of standalone Virtual reality and Augmented reality components.

Fig 1. Microsoft Hololens
Fig 2. Google Tango Tablet

The following are the concept pictures of our deliverable

Fig 3. Overview of our project, showing virtual landscapes built on real planes.
IX. Conclusion

To conclude, this project aims on integrating virtual objects into the real world in the sense that the virtual objects are displayed as if they were actually exist in the reality, and thus we hope we can introduce its powerful potential on practicality to others. Besides the development on individual mixed reality, we also try to collaborate different devices to show innovation of HKU CS department as the first tier education institution.

X. References