Glycoscience Augmented Reality Application Demonstrated with Merge Cube

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Abstract
Popular science education of biomedical knowledge can be monotonous and beyond understanding, so it is necessary to involve fun elements and to harness the suitable demonstration tool to make it more approachable. Merge Cube, a cube-like object trending on the Internet, has an iconic design of pattern recognition which is suitable for augmented reality (AR) applications. This has built up Merge Cube's popularity among schools and it has now been gradually included in popular science education for teenagers. Nowadays, application of augmented reality has been widely implemented in all sorts of fields besides popular science education, and it is often promoted via the Unity software due to the software's easy-to-use and highly compatible feature. These sorts of application can be performed with the cameras in common mobile devices, making it convenient to be spread among the public. Also, when the virtual images are placed in a real-world environment, more interactions can be stimulated, resulting in dynamic changes throughout the process. In the article, we will use Merge Cube as the platform and the Unity software as our tool to produce biomedical contents respectively and integrate them into large scale projects. By simply holding the Merge Cube in front of smartphones, users will be able to demonstrate all kinds of digital content to others. Our main demonstration content in the article will be focused on glycoscience education and related 2D teasers, RPG games and 3D games etc., and we aim to bring users a brand-new experience in the augmented reality environment.

Keywords: Augmented Reality, Glycoscience, 3d Model, Animation Teaser

1. Introduction

According to Market Research company Digi-Capital, the total valuations of global Augmented Reality and Virtual Reality startups have set a new record high at $45 billion in 2019 (Digi-Capital, 2019). By 2023, the AR market might even reach $85 billion. Since the launch of Pokemon GO, AR games have proved themselves eye-catching to the mainstream population (Jang, & Liu, 2020). These reports showed that as AR and VR technology have ignited digital transformations across all industries, vendors are sure to grasp this business opportunity. Thus, the application of AR technology will become more common in our daily lives, and may deeply influence our future.

As one of the industries embarking on their digital transformation journey, the Biomedical industry has no excuse to be left out. In Taiwan, cancer is listed as the first leading cause of death, however, related biomedical knowledge such as Glycoprotein, Precision Medicine, Targeted Drug, Genetic Test, Next Generation Sequencing, Induced Pluripotent Stem Cell etc. aren't commonly-known to the general public. For instance, what is Glycoprotein? Is Targeted Drugs really a panacea to cancer? Does everyone need to run a Genetic Test? For those without medical background, these questions are not easy to answer.

Thus, in this paper, we will focus on the application of AR technology in promoting glycoscience, a biomedical knowledge. We will discuss about the details in the paper and further explain the results of this project.

2. Background

What is Augmented Reality (AR)? It is a kind of interactive technology which integrates digital data, such as sound, images, videos etc. with the real world. By overlapping 3D virtual objects with the real world, infinite possibilities can be displayed. Gerber (Gerber, 2013), a foreign entrepreneur, even predicted that the way of integrating the real world and digital technology will become the main battlefield for the technology industry, and that AR will make an impact to the world so great that no one is capable of imagining, just like what Internet did in 1995.

To define Augmented Reality, Azuma (Azuma, 1997) pointed out at least three characteristics: (1) It integrates virtual and real world; (2) capable of realizing real time interaction; (3) Operates in a 3D environment. In practice, the AR technology is demonstrated with AR display technology and recognition technology. As a kind of visual amplifying technology, the AR technology is greatly related to display technologies such as head-mounted technology, non-head-mounted technology, transparent panel and Holography, which can display both real-world and virtual objects. The display technology can be seen as the core technology of AR, since it is able to identify objects in the real world and precisely overlap virtual objects on the position of real-world objects. Thus, this kind of technology has been diversely applied in specific marking, image recognition, feature recognition and GPS navigation.

The main components needed to build an AR system are, a display monitor, tracker (camera), and illustrating computer and software (recognition technology). In recent

years, these components' efficacy has greatly improved, boosting AR applications as a result. For the application of AR, Feiner in 2002 has pointed out multiple possible applications in the future (Feiner, S. K., 2002), which has already been seen in different fields nowadays. For example, in the cultural and creative field, you can play an AR game with your smartphone at historical sites (Ardito, Buono, Costabile, Lanzilotti, & Pederson, 2007); in educational trainings, AR technology is applied to help students understand more about their campus and other outdoor information (Wang, et al., 2011); when applied in the medical field, AR technology is used in surgeries (Ha, & Hong, 2016) and anatomy education (Hackett, & Proctor, 2016); other fields of application also include digital learning (You, & Neumann, 2010) and music and entertainment etc.

3. Executive Conception

Biomedical is a professional field, which makes it hard for the public to understand or get involved in it. One of the methods we use to make the knowledge of this field more approachable is cross-disciplinary teamwork. In the process, different works will be assigned to three departments. One department can transform frontier biomedical knowledge into popular science materials. Another can develop interesting and innovative resource modules of popular science. The other can help complete trials and assessment on schools in cognitive, affective and psychomotor domains. In this paper, we will put our focus on building resource modules of popular science education, and to promote glycoscience knowledge by combining the basic concepts of popular science and AR technology. We expect to advocate the importance of glycoscience with AR technology, and explain that the variation of carbohydrate molecules is a vital index of cell canceration, which makes a great impact on our health.

The basic system structure of AR glycoscience demonstration is shown in Figure 1. It includes Two-Dimension (2D) models, Three-Dimension (3D) models, Interactive Teaching and the Hall of Fame. The 2D and 3D models reveal the design and production of basic media elements; Interactive Teaching is the core content, which consists of trailer animation, basic animation, advanced animation, basic game and advanced game; the Hall of Fame is where we will introduce the scholars who have contributed greatly in Taiwan's glycoscience research. In the final AR platform presentation, we will use the fun and interesting Merge Cube to display the animation teaching module and game teaching module. We will include random questionnaires in games or animation in order to help users learn about glycoscience. Adding some challenge in the learning process, we divided the stages into basic and advanced levels. Users will have to compete with one another and answer the questions correctly in order to complete the stages.

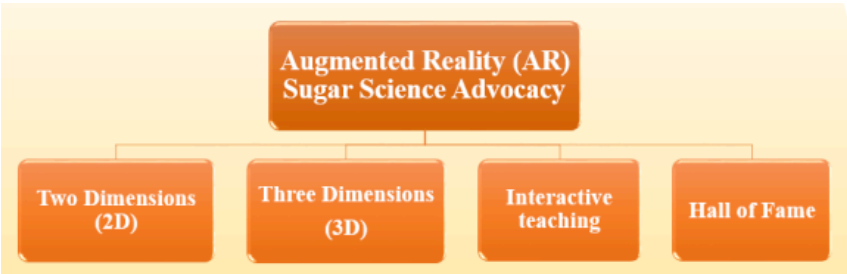

Figure 1: The basic system structure of AR glycoscience demonstration

During the process of carrying out the project, we will first collect some data from the popular science materials for advocating purposes, and then transform those materials into a story in order to build an amusing teaching environment. The story will be about a main character's series of adventures in the human body after she was accidentally brought to a Magical School.

4. Results

Tim Brown, the master of Design Thinking, once said that the final key element of design thinking is developing a script and telling a good story (Brown, 2010). In order to make glycoscience knowledge easier to digest for the public, we followed this concept and designed a story. The story will be set at a Magical School, and the main character will go through a series of adventure in this setting. The following are the results we have accomplished in this project:

4.1 2D Art Design

4.1.1 Character Design

Characters will include Lily, Carby, the Dean, Associate Dean etc., and among them, Lily and Dean will both have a suit of clothes from the Magical School and one from the real world. Besides, each character will have their exclusive facial expression pack for RPG dialogues. The appearance of Lily and the Dean are as follows:

Figure 2: Lily, the main character's appearance

Figure 3: The Dean's appearance

4.1.2 Set Design

These are the backgrounds for RPG dialogues.

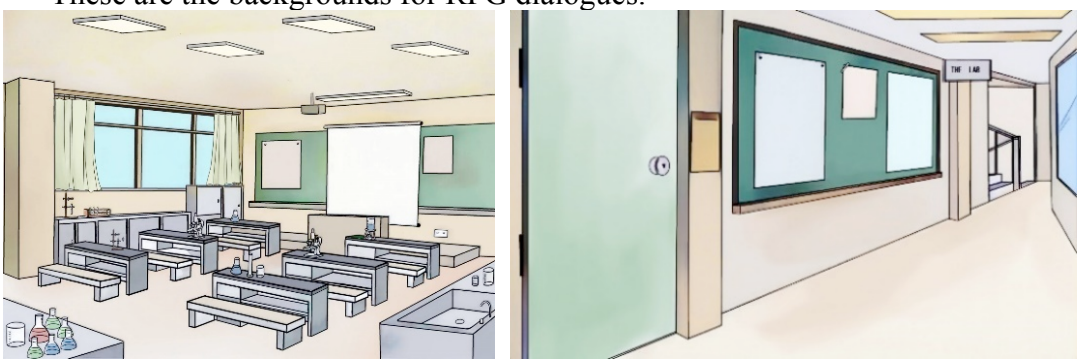

Figure 4: Set Design_1

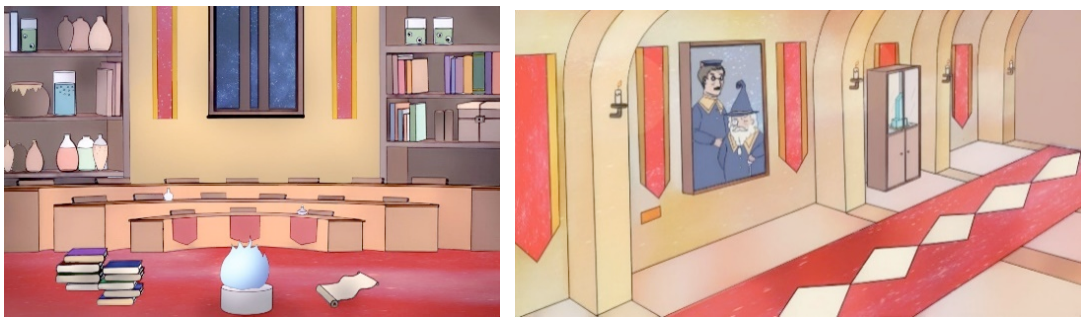

Figure 5: Set Design_2

4.1.3 Trailer Results

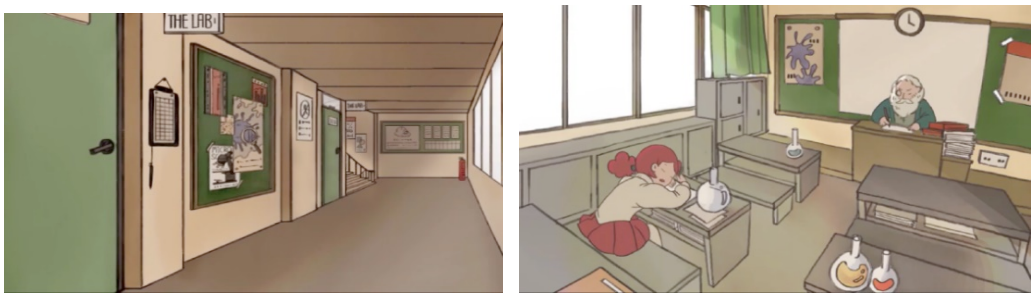

Figure 6: Captured image from the Trailer

4.2 3D Art Design

Objects and characters including Lily, Carby, Dean of the Magical School, red blood cells, virus, bacteria, cancer cells and magic books etc., will go through 3D modelling according to the planned animation and game. The 3D modelling of Lily, and red blood cells are as follows:

Figure 7: 3D modelling of Lily

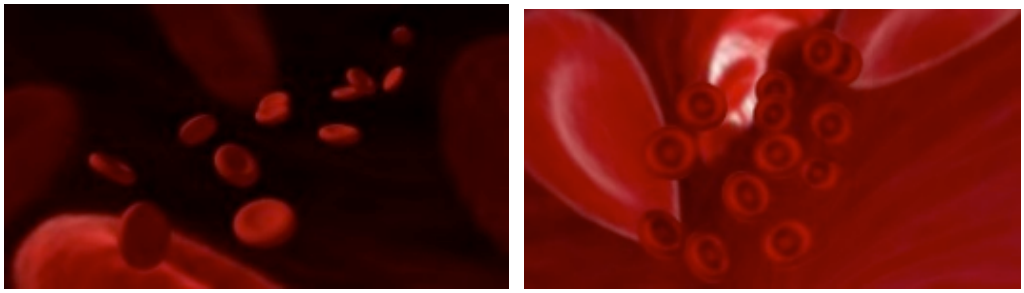

Figure 8: 3D modelling of red blood cells

4.3 Teaching module of animation (3D animation)

The basic level animation of the Merge Cube AR Platform can be previewed as follows:

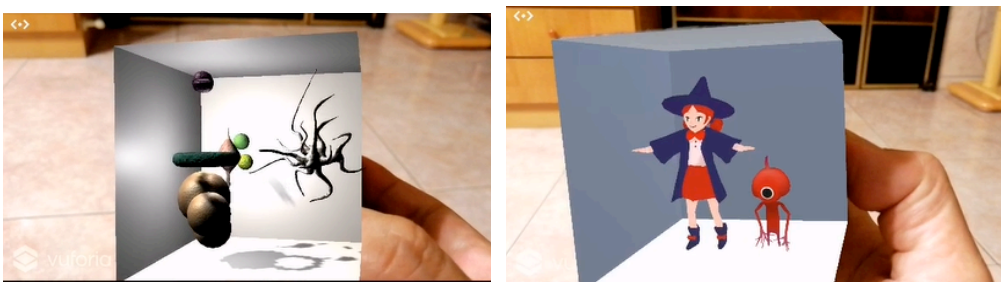

Figure 10: Captured image of the basic level animation

4.4 Interactive teaching module (game)

4.4.1 RPG Interactive Dialogues

Figure 11: Captured image of RPG interactive dialogues

4.4.2 Merge Cube AR Platform basic level game

The game can be previewed as follows:

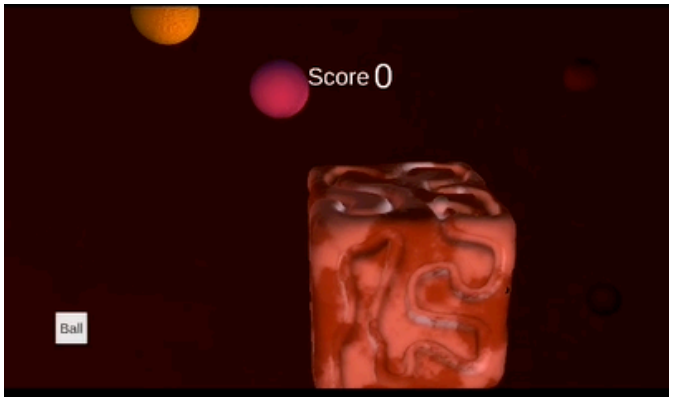

Figure 12: Captured image of basic level game

4.5 The Hall of Fame

The layout design of the Hall of Fame is shown as follows, taking Chi-Huey Wong, the ex-Dean of Academia Sinica, as an example. The content will include name, date of birth, educational background, past experiences, current job, awards, outstanding contributions, and main achievements etc.

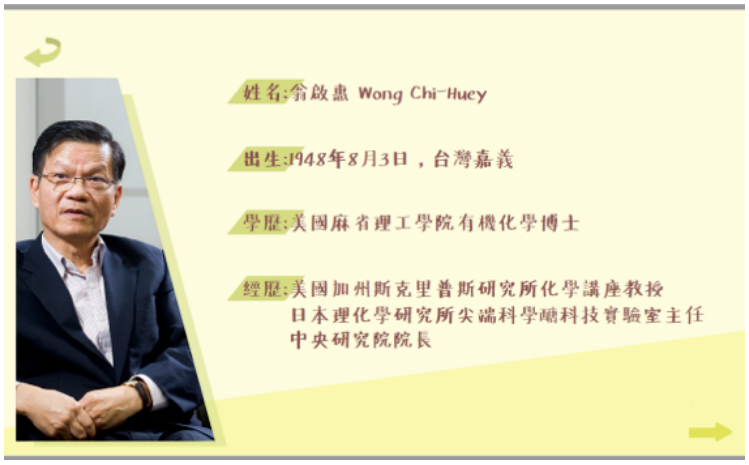

Figure 13: The layout design of the Hall of Fame

5. Conclusion

In this paper, we brought out the idea of applying AR technology to the advocacy of Glycoscience. Under the process of executive conception, planning, implementing, design and production, we completed the two-dimension art production, trailer animation, RPG interactive dialogue, three-dimension art production, the basic level animation and game of the Merge Cube AR Platform etc. Moreover, we combined all these work into an animated story, adding visual effects and questionnaire games to engage users. We also built a multimedia educational training module which is available for follow-up assessment and revisions, and results will be used in the final advocacy event.

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