Approach Augmented Reality Real-time Rendering for Understanding Light and Shade in Art Education

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Abstract— **This paper propose is approached the integration of Augmented Reality (AR) system and Real-time rendering to enhance the process of Art education, that create the new learning experience and better quality of teaching. According to the subject about light and shade, which every art student must learn. By understanding how light operates on the fundamental volumes of the shape such as sphere, cylinder, and cube. The student will be able to realistically shade and render basic forms and be prepared to draw more complex subjects. However, the teaching process is through illustrated books, which hard for the student who did not have an experience in Light and Shade to clearly understand the method. Augmented reality technology is able to support the effective way to describe how light and shade work. By showing the shape in three-dimension with light and shade. From real-time rendering technique, the light source can move around to cast the different appearance of light and shade. It is simple to use and understand for student. Furthermore, Augmented reality enhanced interesting way to study in the way that computer screen cannot deliver.**

Keywords—*Augmented Reality; Real-time Rendering; Light and Shade; Art Education*
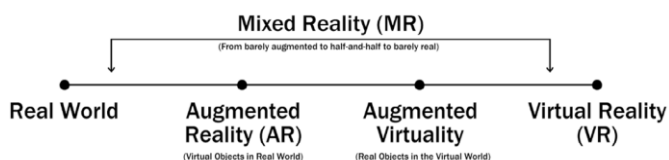
I. INTRODUCTION

Fig. 1. Mixed Reality Virtual Displays

In the last decade, AR has been well known for digital information such as Graphics, Video and Sound integration with the real world. See Figure 1 for a graphical depiction of AR that brings virtual objects approach to the real world. Which enhance the new experience for people to be able to see the existing environment overlay by digital content. AR provided more boundary and opportunity in any industry, for example, Marketing, Tourism, Healthcare, and Education. In 2018 AR device market was expected to reach $659.98 million.

During last 4 years, the number of in AR education has been progressively increasing. AR was used in 86 countries and reached more than 80,000 teachers and students in the classroom with various fields of study. Also, reach in many students in every part of the world by using the only smartphone. AR help in many ways to making complex information is easier to understand. Due to 21st-century classroom idea, the process of learning does not have to be in the classroom anymore. Students should able to access the knowledge anytime, which technology can support this idea and provides more opportunities for students to express their creativity and push more learning motivation which extremely important in Art education.

Light and shade in art lesson are significant in many ways, it made the drawing look real, also express the feeling of the works. The art students taught to learn this lesson by the papers and books, which has a few images that were not covered in every situation. Some student unable to understand how light and shade work through pictures. Light and shade that interact with objects are complicated than the book could describe.

This research aims to use Augmented Reality technology to support in light and shade lesson in art education, that could help the student to understand the subject and be motivated in the learning process. They could create the mind-blowing works from great attitude of studying

II. APPROACH

A. AR Realtime Rendering

The optical AR means showing virtual object emerge to the real world by AR calculate location technique from a marker, where the real world is recorded by a camera, both virtual and real objects were shown on a mobile display before the user's eyes. The importance of real-time-rendering can use light and shadow to support present with the real world. That solution

could prepare 3 layers from calculating and setting step to the presentation on the mobile display; 1. Layer form background is preset recorded with a camera, 2. Layer of Light and shadow is present only Lighting and shadow without rendering virtual object and the Last layer is present only virtual object.
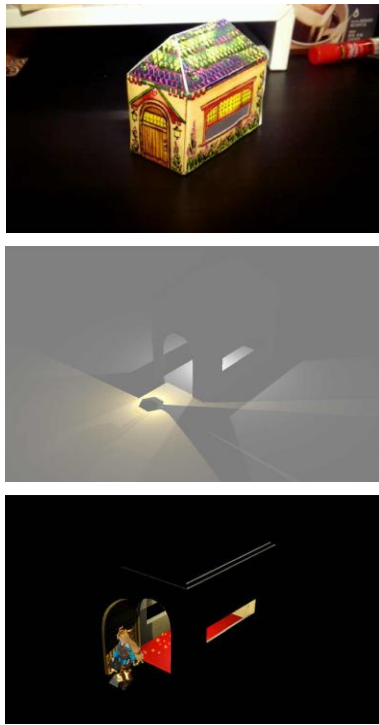

Fig. 2.   Layer of Presentation

That Program will follow up to this diagram is simple to use with AR and the main point is focus on Adjust light source and camera angle, so the save picture function was prepared user-friendly to use when complete to set up the light source and camera user don't hold that process.
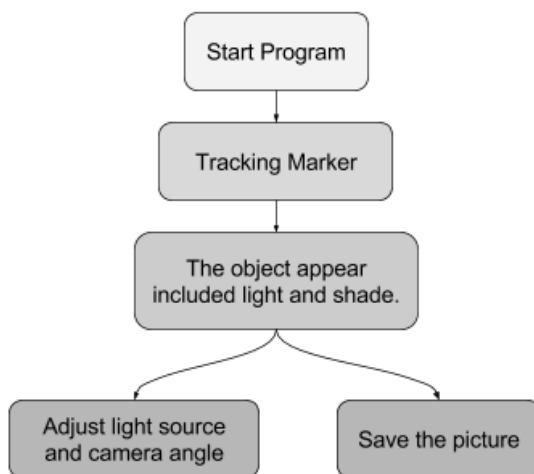

Fig. 3.   Application Working Process

B. Light and Shade study

As drawing is the process of expressing the artist's feel to the world, like everything they draw is a representation of seeing. Especially when the artist does realistic painting, it may be realistic without any recognizable shapes or outlines, they only put a few patches of color, light, and shadow to bring something familiar to mind. Since the theory of optics has been discovered, A light ray hits an object and bounces to your eye. Then the signal is processed by your brain and the image is created. Which followed by an important rule of a painting: "light is the only thing we can see. It's not an object, not a color, not a perspective, not a shape. We can see only light rays, reflected from a surface, disturbed by the properties of the surface and our eyes. The final image in our head (Zagrobelna 3)." That is mean, when someone painting, what they paint is light come along with shadow. Shadow is the area untouched by light, which this lesson is complicated than pictures could explain. As figure 2 show the picture most books used to explain how light and shade work on the object with a single light source.
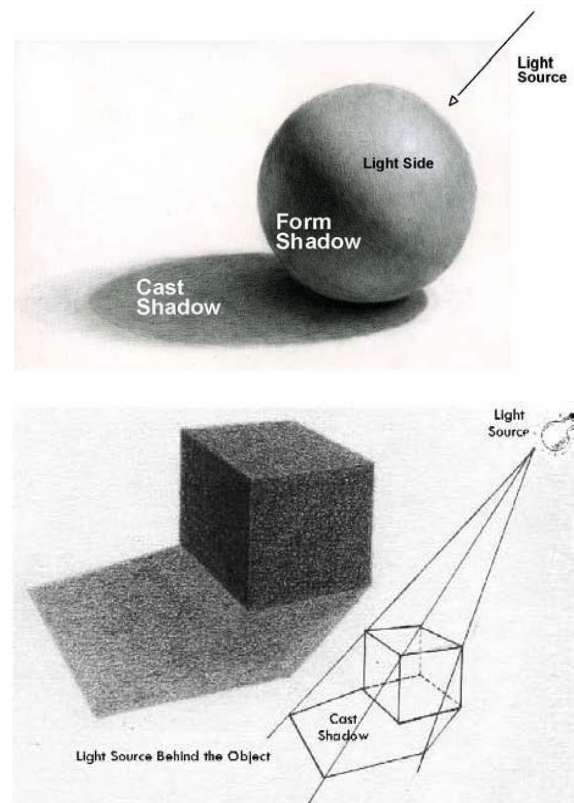

Fig. 4.   Light and Shade example in the lesson book.

The picture can show only one angle of light some student unable to understand when the light source moves at the different angle. If they try to set up the object and light at their home, it difficult because normally home does not have one single light source to achieve a realistic drawing successfully. Learning with a single light source is strength fundamental

before a move to advance lighting lesson with many light sources. The concept of handheld tools that help set the light source and able to move it around, make shade in the different angle with the different fundamental object, could help the student to understand this lesson.

C. 21 Century education

The idea of education in this decade has change from traditional learning into 21st-century education Which is a big transform. Since new technology has been invented, they were used widely in the education system. One of the most popular ideas is flipped classroom, which means the student does not have to learn only in the classroom also create the active learning environment emerging with technology that the student could learn at their own pace and have the motivation to concentrate in the topic. Teaching is not giving idea, insight or filling student with a load of information anymore, but gave them the concept that they can apply. Technology such as mobile phone is extensively used in the most student from various benefit and cheap price, furthermore, it can be a valuable tool for studying. Many applications were invented for driving student into learning lesson, gave them entertainment while intertwined with knowledge. Augmented Reality is one of the great tools for 21st-century education, the student can use their own mobile phone, not only in class but anywhere so they can learn and interact in the specific lesson.

III. APPLYING

A. Augmented Reality to Light and Shade lesson

Light and shade lesson is important to every art student. It requires many understanding, experience, and practice. So, we develop the Augmented Reality Application for art student in beginner to intermediate level. The application included markers that represent the objects that user want to interact with. We design a simple user interface that easy to understand. Start with open mobile camera in AR application then the three-dimension object going to appear in the screen, the user can move the light source that appears on the screen around to create light and shade in the different angle. The user can learn the lesson in between using the application.
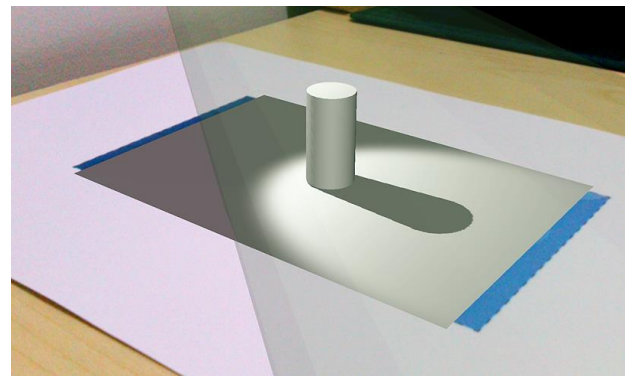

Fig. 5. The result example from our application with the light source from left-side.
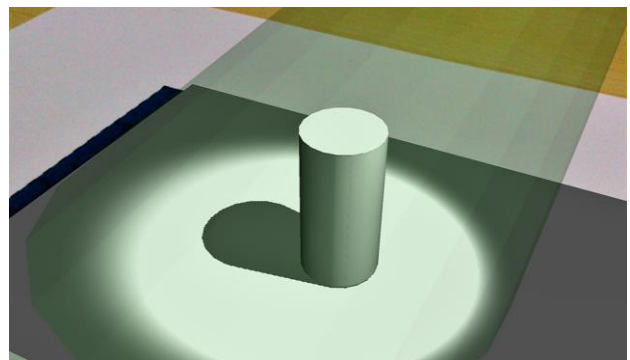

Fig. 6. The result example from our application with the light source from right-side.
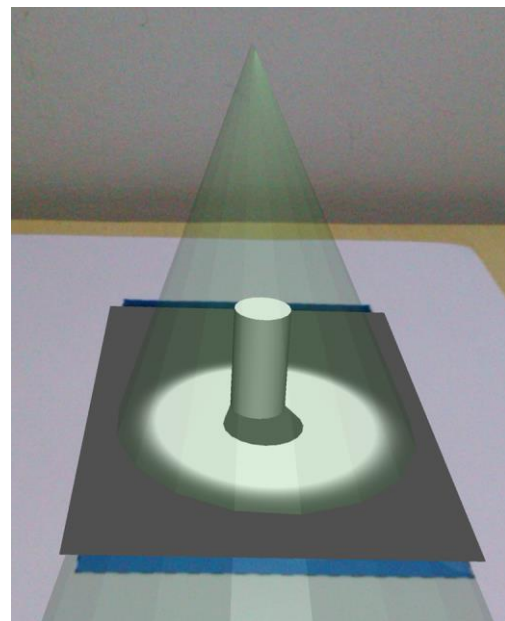

Fig. 7. The result example from our application with the light source from top.

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IV. CONCLUSION AND FUTURE WORK

This research propose is using augmented reality to emerge with art education in light and shade lesson which is hard to truly understand from the book or description so the Augmented Reality technology could use to help student or person interested to comprehend about this lesson by seeing the three-dimensional object with light and shade that can interact with. The student could see the idea of light and shade clearer and understanding.

In future work, we could develop the application for support more advance light and shade lesson. The user could import their own created three-dimensional object into the application also able to create the more light source with the real light and shade technique, to enhance the real environment for advanced light and shade study. Including apply the light and shade in the 3D model for learning new material.

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