The Virtuality and Reality of Augmented Reality

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Abstract— **This thesis explores the creative possibilities and implications of Augmented Reality, not just as a specific technology of computer science, but as one of high technologies that influence people's perception and even the concepts of the real and the virtual. For a broader definition of Augmented Reality which has a unique status between virtual environment and real environment, the virtuality and the reality of Augmented Reality are discussed in an interdisciplinary context such as arts, philosophy, and film and animation studies. This approach is rooted in the belief that theory of new media ought to traverse and encompass all realms of academic categories.**

Index Terms— **Augmented reality, virtuality, reality, perceptual reality, second-order reality, possible worlds theory.**

I. INTRODUCTION

Suppose a philosopher of 17th century, John Locke was alive in this 21st century, how would he categorize Mixed Reality with his terms of primary qualities and secondary qualities? He tried to differentiate something objective, mathematical, and physical from something subjective and psychological. According to his way of thinking, primary qualities include solidity, shape, movement, or numbers and secondary qualities include color, sound or taste. Mixed Reality, however, is not so easy to be defined in this way. In particular, among the subdivisions of Mixed Reality, Augmented Reality seems to be the hardest and most complicated concept to be defined.

Although Paul Milgram, Haruo Takemura, Akira Utsumi and Fumio Kishino (1994) are definitely credited for the groundbreaking article that has been the milestone of taxonomy of Augmented Reality, the concept of Augmented Reality has hardly been interpreted enough with reference to other academic fields [1]. This fact might restrict artistic potentials of Augmented Reality and impede the progress in applications of Augmented Reality. In their Reality-Virtuality Continuum, they place

Augmented Reality between real environment and virtual environment, closer to the former. Hence, the Reality of Augmented Reality should be a primary quality and the Virtuality of Augmented Reality should be secondary one.

This approach to Augmented Reality is primarily based on the Reality-Virtuality Continuum, but it is also rooted in the nature of computer graphics technology itself manipulated in it. The technology probes into mainly two directions, virtuality and reality. It creates imaginary, fantastic and extraordinary images which can never be created by other means except computer and also tries to provide some more realistic or mimetic representation of the real which has been main concern of arts.

Computer seems to be more competent for the former. This might be one of the reasons why Virtual Reality has been the centre of all disciplinary studies and enthusiasm, originating novel and unique aesthetics of it. However, this thesis emphasizes the latter, the reality, which is still more challenging theme for computer graphic designers and scientists and which is closely connected with the tradition of realism.

Augmented Reality, which mainly consists of real elements and trickily contains virtual elements, is a proper theme for probing the virtuality and more importantly, the reality of computer generated images created by high technology.

In this paper, these two qualities of Augmented Reality are restated in terms of Second-order reality, perceptual reality, the two similar terms raised in the film and animation studies and also of vocabulary of other fields. Ultimately, this paper aims at a turn in speculations of Augmented Reality in an interdisciplinary context.

II. THE VIRTUALITY OF AUGMENTED REALITY

A. The Brief History of Virtual Reality

The concept of Virtuality was originated from the concept of Virtual Reality. Around mid 70s, a pioneer of media artists, trained as a computer scientist Myron Krueger coined the term 'artificial reality' and 'video place.' Later, the name of Virtual Reality has come to the world by Jaron Lanier, a computer scientist in 1989. For

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him, Virtual Reality is something imaginative, graphic, auditory and interactive.

Philosophical enthusiasm filled the end of last century, particularly 90s. Among them, Michael Heim even used a term, 'Virtual Realism', meaning "an art form, a sensibility, and a way of living with new technology [2]." What is unique about Heim is, as a philosopher, he regarded Virtual Reality as a technology, primarily. Ted Nelson, a philosopher and sociologist credited for the inventor of hypertext, argued that everything has a reality and an virtuality. According to him, virtuality is the seeming of anything and consists of conceptual structure and feeling.

Now, it goes without saying that Virtual Reality is an essential part of real life. Though there still exists some more ways to go technically, Virtual Reality has already stolen into everyday language for common people. Lev Manovich pointed out that virtuality had been discussed excessively and now it cannot indicate any specific thing.

B. Virtual Reality in Everyday Language

Like above, most people over the world are used to the word of Virtual Reality. Nevertheless, as we can see from that MS office 2003 cannot recognize the word virtuality as a grammatically correct word, the meaning of virtuality has not been clearly established yet. Definitely, people know that it is neither illusion nor delusion, but how people distinguish it form the others?

Translations reflect the way how a concept is understood in certain culture and sometimes even what people's insight into it is. This is indeed true particularly in translations from English to Far Eastern languages, that is, from phonogram to ideogram.

Something virtual, or virtuality are translated into a compound word made of two Chinese characters in Korean, Chinese and Japanese in common. The first character means something false or temporary and the latter means idea or thought. Then, is virtuality a false idea or a temporary idea?

In addition, the translation of Virtual Reality into Korean and Japanese are compound words, by adding two more letters meaning reality. Virtual Reality in Chinese, on the other hand, is translated into different characters. In this case something virtual is thought to be something empty and something similar. Then, is Virtual Reality something hollow but similar to reality?

Webster online dictionary explains that virtuality refers to either 'potentiality, efficacy and potential existence' or 'the quality of state of being virtual.' Then what does 'the word virtual' refer to? HapperCollins dictionary explain something virtual refers to 'something is so nearly true that for most purpose it can be regarded as true' or 'objects and activities generated by a computer to simulate real objects and activities.' However, is Virtual Reality potential, nearly true or even false?

C. From Virtual Reality to Augmented Reality

Though the term of virtuality itself or the virtuality of Virtual Reality cannot give a good and concrete answer to these questions, virtuality of Augmented Reality can be a very good counterevidence.

Both of Augmented Reality and Virtual Reality share interactivity, three dimensional images, and other factors. Yet, the differences between them are quite evident.

First difference is the level of immersion. Augmented Reality never lets a user lose a sense of presence in the real world as it supplements some part of reality with virtual factors. In contrast, Virtual Reality completely consists of computer-generated factors, which makes a user totally immersed in it. In other words, a simulated, artificial environment replaces the real one in a Virtual Reality system. Next, Virtual Reality limits a user's physical movement out of a studio, whereas Augmented Reality requires portability of the system especially in case of outdoor Augmented Reality like navigation and games. From these differences, we can assume that real factors are the very unique quality of Augmented Reality.

Throughout the history of Virtual Reality, one can see Virtual Reality in bloom at a very interdisciplinary ground, where inspiration and efforts of scientists, artists, philosophers, engineers and writers integrate. Why not Augmented Reality? It is still a relatively untapped territory except for the scientists.

Regarding Augmented Reality, it mainly consists of the real world and supplemented by virtual factors generated by a computer. Then, those images are displayed after they are seamlessly synthesized not just juxtaposed, either in monitor-based way or optical see-through way. Unlike compositions of photorealistic virtual objects and the real scene in films, it requires interaction with viewers. More importantly, all of the process should be in real time, contrary to complete virtual environment created beforehand. Augmented Reality is not just what we are looking at, but also what is really happening here and now. Can it be told to be potential? Can it be false? Or is it better to say nearly true?

Jacque Derrida introduced that the Greek word 'skepteon', a noun form of a verb which means 'to look' in English [3]. Indeed, now is the time when people cannot but be skeptic or may well be skeptic about what they are looking at. To see is no longer to believe. According to Derrida, to see might not always have been to believe even long time ago. Moreover, to see does not necessarily mean to believe. It is not important whether we believe it or not. It is because we are already going further into the world of virtuality, or we are already accustomed to, as Richard Allen calls, 'sensory deception [4].' People of the Renaissance were fascinated by the

TABLE I.
VIRTUALITY AND VIRTUAL REALITY IN FAR EASTERN LANGUAGES

	virutality	Virtual Reality
Korea	假想	假想現實
Japan	仮想	仮想現実
China	假想	**虚拟实境**

invention of perspective technique and were willing to let their own sensation be fooled by it. Yet, virtuality generated by computer creates a different dimension of sensational experience, stimulating not just visual sense, but all human senses.

Augmented Reality 'augments' this kind of complicated questions, or skepticism.

III. THE REALITY OF AUGMENTED REALITY

A. Mimesis in Arts

Mimesis means representation or imitation of nature, if its meaning is most simplified. More specifically, it is connected with the works and thoughts of Plato and Aristotle on creation by human beings, especially on artistic creation.

When mimesis is discussed, there is a classical story which is always cited from Western culture. The competition between legendary painters, the story of Zeuxis (B.C. 5C~4C) and Parasios (B.C. 420?~380?) is the one. When Zeuxis painted grapes, birds were fooled by the realistic painting and flew up to it. He grinned at his rival proudly, asking to open up the curtain on the painting. Parasios answered that the curtain itself was a part of painting.

This story is one of universal legends. There are also Korean versions of similar stories. There was a painter named Solgeo(?~? 6th century) painted an old pine tree on the wall of a temple. It is said that birds as poor-eye sighted as Zeuxis's ones tried to rest on the branch of the picture only to fall down.

 Moreover, this kind of story doesn't belong to the ancient times. Around 16th century, when a famous female artist Shin Saimdang painted glasses and insects, chickens tried to pick the insects from the painting. Fig.1 shows her delicate painting style but it does not appear that much realistic from the modern point of view based on perspective of Western tradition.

Why have people always obsessed with depicting the nature as realistic as possible? And why these legends say that great art works created by geniuses' hands can deceive not just the eyes of people but those of the nature?

The answer might come from the ancient philosophers' idea about mimesis. According to Aristotle, human being has a mimetic urge to create something represent nature. In addition, realistic representation sometimes appears to imply a human challenge to human perception and even the creative power of god. In some cases, computer graphics technology is eager to succeed to these techniques driven by similar urge.

Trompe l'oeil means 'eye-deceiver' in English. These paintings give a three dimensional perception form a two dimensional canvas and sometimes categorized as a kind of Illusionism. As it is shown in Fig. 2, trompe l'oeil paintings playfully blur the boundary between real space and illusionary space in them.

Although this kind of eye-fooling images have existed since the Hellenistic times, as mentioned before and still exists as a category of art, trompe l'oeil flourished twice in art history, the Renaissance and the 17th. The very important point of trompe l'oeil is that it was actualized by the development of science. During the Renaissance, the discovery of mathematically correct perspective and the development in pigment were the driving force of the development of trompe l'oeil and the science of optics enabled the 17th century's Dutch painters to draw the most realistic still life paintings.

The reality of Augmented Reality can be interpreted in this context. Trompe l'oeil explores the boundary of reality and so does Augmented Reality. With bare eyes, a viewer feel confused by what he or she is looking at, in front of a realistic illusion of trompe l'oeil painting. George Washington, for example, is said to have been fooled by a trompe l'oeil painting, Charles Willson Peale's *Staircase Group* (1795). Augmented Reality challenges a viewer's perception, either in a vision based way or a device based way.

What should be noted is that neither of them requires viewer's losing a sense of reality, that is, full immersion. In addition, particularly, the playful aspect of trompe l'oeil is similar to that of digital images in Augmented

Figure 1. Insects Painting, Shin Saimdang, 16th century.

Figure 2. Escaping Criticism, Pere Borrell del Caso, 1874.

Reality applied in art works or games. Furthermore, trompe l'oeil technique is applied not just in paintings but also in architecture like murals, doors and walls. This reminds Augmented Reality widely applied in the field of architecture or archaeology.

On the other hand, the critical difference lies in the quality of images, that is, the analogue images and the digital images. Also, the intentions of creating realistic images are different from that of trompe l'oeil painters' and much more varied. Lastly, the special devices for Augmented Reality lead viewers to a relatively deeper immersion, sometimes these appeal to other senses, in addition to visual sense.

The most recent category of art which can be referred in this context is super-realism Paintings of 1960, 70's, also known as photorealism Paintings, hyperrealism paintings, radical realism paintings, sharp focus realism paintings and photo art. Super-realists consciously work with photos, projecting slides onto canvases or sometimes developing and printing photos on them as seen in Fig. 3. The representative super-realist Chuck Close said that the main goal of his photorealistic paintings was to convert or translate photographic information into pictorial information.

The result is usually visual excess with giant scale revealing what human eyes cannot see. Overwhelmed by this strangely unfamiliar image, viewers doubt their usual perception and what is called 'real.' The fact that super-realism paintings provide a better or exact way to see things and also a representation of camera's vision created by refined human skills evokes what Augmented Reality does.

B. Second-order Reality of Animation

Andrew Darley explains a new aesthetics of animation with those super-realism paintings [5]. Both super-realism paintings and animations create images that have verisimilitude. According to Darley, however, they have different intentions. The former shows perfect mimesis itself is not possible and rather criticizes the photorealistic imitations of the real. On the other hand, the latter intends to simulate images in the most photorealistic ways by the aid of cutting-edge computer graphics technology. Yet, computer-generated or virtual images do not have specific models in the real world. Unlike photography in a traditional sense, or analogue photography, they are not the proof of existence. Even though they look perfectly photorealistic, they are not indexical but completely iconic. This is what Darley named 'second-order reality.' He argues that new technologies of digital imaging produce old ways of seeing and representing.

In the series of *Garfield*, for example, the 'virtual' cat Garfield looks photorealistic except the exaggeration of his facial expressions. In Fig. 4, compared with the 'real' dog next to it, the 'virtual' cat looks so natural in every aspects, such as, its density in the real space, interaction with other real characters and the reflection of his in the glass of the table. However, unlike the 'real' dog which really exists, or at least once existed in the real world, Garfield does not belong to this world.

Now, reality of an image is different from a problem of physical existence. If the image is digital one, moreover, its reality also needs to be seen from another angle, as Darley argues. Likewise, when we consider the reality of Augmented Reality, the definition of reality itself should be updated.

C. The Realism of Film

Andre Bazin argues that there are 3 types of realism in film, which are an ontological realism, a dramatic realism and a psychological realism [6]. A ontological realism is about existential density and weight of presence which objects and decors possess in the scene. The cohesion of the foreground and the background is called dramatic realism. Lastly, a psychological realism brings spectators back to the real conditions of perception, a perception which is never completely predetermined.

Steven Heath adds here the 4th realism, the impression of realty, when these realistic conditioned are satisfied. This mechanism of experience can be applied to explain both spectators' immersion into film and users' immersion into Augmented Reality.

Artist Paul Klee believed that there exist numerous other worlds and the world we know was just one of them. He added that he drew the other worlds. His words is resonant with philosopher Leibniz's comment on possible worlds and the possible worlds theory bloomed in
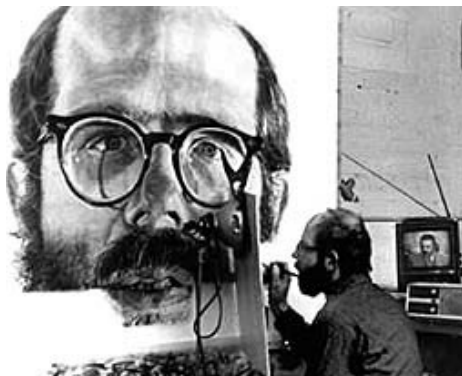

Figure 3. Chuck Close working on his portrait

Figure 4. Garfield A Tail of Two Kittens

1960~70's by S. Kripke and others. It is about counterfactuals, which suggests that there is a plentitude of other possible worlds along with this actual world.

Warren Buckland notes the possible worlds theory can explain why Spielberg's dinosaurs catch our eyes [7]. According to him, the dinosaurs are attractive because they exist between 'science fiction' and 'science fact.' Dinosaurs cannot be physically with human beings as it is in the film *Jurassic Park* or *The Lost World*, but the film raises a hypothesis that we may be able to recover the dinosaurs' DNA by aid of modern genetic engineering technology and bring them back to the earth. The film proposes its hypothesis supporting it with enough probability and audiovisual reliability.

It is also true n case of *The Host* in Fig. 5, a Korean film introduced at Cannes Film Festival in 2006. This film attracts spectators with its hypothesis that there might be a genetically mutated creature by pollution in Han River of Seoul. It is cutting-edge computer graphics technology which makes all these things perceptually harmonious.

D. Perceptual Reality of Augmented Reality

Stephen Prince suggests that realism is no longer a problem of reference, but it is a problem of perception [8]. As numerous images in films, virtual images are unreal but also perceptually real. These are harmonious with spectator's perceptual experiences because they are made to be so. This intention is what film makers and computer engineers who create Augmented Reality have in common.

Yet, their works to generate virtual images and coin them into real images have rarely been taken as a similar process. An approach from a different angle to discuss realism in computer generated images. These views are not rare in the field of film and animation studies but seem to be isolated from studies of Augmented Reality despite their basic and common factors.

When virtual images of Augmented Reality can be inserted seamlessly into the real environment, a mechanism of perception, that is so much alike spectators' perception of special effects of films, works.

Look at the images of Fig. 6. Most people know that Tom Hanks shaking hands with John F. Kennedy is a result of special effects of the film. Indeed, image (a) is a scene taken from *Forrest Gump*. On the other hand, image (b) in which former Korean president J. H. Park sitting next to Mr. Kennedy is a real one. Suppose a viewer who does not have any information neither about the film nor the Korean history is made to judge these pictures. He or she could not tell on from the other but the difference in resolution. The images merged are not distinctive in perception but in information if they are simulated without technical flaws.

We can assume that the reality of Augmented Reality is better understood in a new context of reality, that is, perceptual reality. Already people's concept for virtuality and reality has changed and the boundary has blurred.

As Steven Holtzman suggests, there is a need for the digital to pursuit what the analog can never do [9]. Belonging to the realm of the digital, however, Augmented Reality still holds the real elements and analog conditions as indispensable part of its nature. We need to establish its own aesthetics different from that of Virtual Reality.

IV. CONCLUSION

The desire for a more realistic representation, or the compulsive pursuit for perfect mimesis seem to be the

Figure 5. The Host

(a)

(b)

Figure 6 (a) Special Effect (b) Historical Photography

drive for developing digital technologies which can be used to create more realistic images, either consciously or unconsciously. It is strongly connected with Augmented Reality because it challenges the human perception.

Throughout the discussion, two qualities of Augmented Reality, which are the virtuality and the reality, are reiterated in an interdisciplinary context of arts, philosophy, and film and animation studies. It is expected to be useful particularly for studying artistic potentials and applications of Augmented Reality.

Augmented Reality is an example of high technologies of which cultural implications and fundamental effects on human life ought to be better understood. Hopefully, this discussion will serve as an exemplary approach followed by other studies on technologies.

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