

**THE EFFECTIVITY OF GRAPHIC AND VIRTUAL REALITY
AS SPATIAL PERCEPTION OF THE MAIN CHAPEL ROOM AT THE
CHURCH OF LIGHT**

SUMMARY

To Meet the fulfillment of the Requirements
Achieving the Master Degree

Master Degree in Architecture and Planning
Concentration of Regular Architecture



Submitted by:

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13/356033/PTK/09150

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Principal Supervisor



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ABSTRACT

The research focused on the effectivity of graphics and Virtual Reality in order to represent spatial perception. Those mediums tested with 40 users and semantic differential questionnaire. Research object was a simulation of the main chapel of The Church Of Light. There was 9 perception category of the main chapel of The Church Of Light found by literature study.

The research used quantitative methods. Research's diagram data was qualitatively analyzed. This research used experiment design and controlled variable of simulation. The experimental design was a layout and crossover design. The controlled variable of simulations was the condition of the main chapel of The Church Of Light.

The research concluded no significant mean differences between graphics and Virtual Reality. The spatial perception of the main chapel at The Church Of Light can be represented from both mediums. According to 7 perception category that be represented, graphics and Virtual Reality can be categorized as an effective medium. Moreover, analyze results to 2 perception category that not in accordance with real condition, specifically to the darkness and detail of the object. This could happen because of lack of quality in simulation product. The lack that produced from the low contrast effect and unmatched material reflection or miss match with real condition.

Keywords: The effectivity of graphs and Virtual Reality, Semantic Differential, The Main Chapel Of The Church Of Light, Experimental Design.

INTRODUCTION

I.1 Research Background

Gibson (1986) in Steuer (1993) said that communication medium brings out Telepresence. Telepresence defined as someone experience of existence to the environment through a medium. Communication medium was an intermediary in delivering the information. It worked to succeeding the delivery of information and decreasing the lack of communication.

Ando's The Church Of Light was a redesign of a church in Ibaraki, Japan. This masterpiece gain the highest award of architecture in 1995. The main chapel room was the icon of The Church Of Light.

The information technology was developed rapidly in this digital era, such as Virtual Reality. Virtual Reality or Virtual Environment is a simulation of space. VR was a 3D visual that simulated by a computer. This technology allows users to interact with the environment. This technology has an advantages in describing a condition or an object. Moreover, users can take a look at the simulation freely at a real time

I.2 Research Question

Regarding to background, the research question is:

1. Whether the spatial perception of the main chapel of The Church Of Light represented through graphic and VR?
2. How is the effectivity of graphic and VR to represent the spatial perception of the main chapel of The Church Of Light?

I.3 Problem Statement

The research focuses on the effectivity of graphic and Virtual Reality in order to represent the spatial perception of the main chapel of The Church Of Light. The effectively referred to the room quality that can be delivered through the medium.

I.4 Research Purpose

The research purposed to evaluate the effectivity of graphic and Virtual Reality with the main chapel of The Church Of Light as simulation object.

LITERATURE STUDY

II.1 Architecture Presentation

Architecture is about presence, someone's experience to interact with others and the environment. The comprehension of an architecture bla bla when experiencing a space. The cognitive process uses as an indicator of the concept and an interpretation of space, it depends with the perception, assimilation, and user interpretation.

II.1.1 Communication Medium

Communication medium was an intermediary in delivering the information. It worked to succeeding the delivery of information and decreasing the lack of communication. Steuer (1993) describes the factor of communication medium as:

1. Presence (Natural Perception)
2. Telepresence (Mediated Perception)

Telepresence defined as someone experience of existence to the environment through a medium. Indicators of Telepresence were:

- a. Vividness

Vividness defined as the quality of image such as resolution and sharpness

- b. Interactivity

Interactivity defined as an explanation of which part of users can participate to change the content through a medium.

II.1.1.1 Graphic

Graphics was belong to the visual medium. Just like others, it has been an intermediary in delivering the information. It worked to succeeding the delivery of information and decreasing the lack of communication. The information was in the form symbol of visual communication. The development was started from a discussion about perspectives that shown in 1435. To serve the fidelity was the main utility of perspective.

II.1.1.2 Media VR (Virtual Reality)

Mihelj et al (2014) in his book, *Virtual Reality Technology and Application*, said that Virtual Reality is an interactive computer simulation that using one or more tools as a replacement of sensor senses for users to immerse in the virtual environment.

A. Element of Virtual Reality

Jonathan Steuer said that there are two main components of Telepresence:

1. Depth of information, quality of data that transferred to simulate the virtual environment such as resolution and sharpness.
2. Breadth of information, how many human sensors that could be manipulated, usually limited in sight and hearing.

B. Tools of Virtual Reality

There are several input tools for Virtual Reality:

- a. *Joysticks or gamepad*
- b. *Force balls or tracking balls*
- c. *Controller wands*
- d. *Data gloves*
- e. *Voice recognition*
- f. *Motion trackers or bodysuits*
- g. *Treadmills*

II.2 Communication

Communication is a delivery process of information such as message, idea, concept, from one to another. Generally, communication delivered orally or verbally.

II.2.1 Visual Communication

Computer visual simulation can be used as tools to represent the spatial perception. Computer visual simulation, such as photo, maps, and model, used with expectations for better quality.

II.2.2 Interactivity

William, Rice and Rogers in Jancowski and Hanssen (1996, p. 61) defined the interactivity as user's degree in communication process. Users have control and capability to the role exchange.

II.2.3 Perception

Everybody has perception or assessment of visual information from the sense of sight. Perception shown differently depends on the age, life experience, intelligent degree, eye disorders, and cultural status. (Sekuler & Blake, 2002).

II.2.3.1 Human Visual Perception

Element of human visual perception¹:

1. *Light Perception*

Ability to interpret the light in an environment through the eye.

2. *Color Perception*

Ability to interpret the color in the range of 380 – 780 nm.

3. *Depth Perception*

Ability to interpret the depth of the object to the body. This ability divided to monoscopic and stereoscopic.

II.2.3.2 Impression

Impression is the process of recognizing the object from visual literacy. The experience of visual literacy is a pattern assimilation process in a communicative way. (Flynn, John E, Hendrick, Spencer, & Martyniuk, 1979).

¹ Mihelj et al (Virtual Reality Technology and Applications, 2014, p. 97)

RESEARCH METHODS

III.1 Research Description


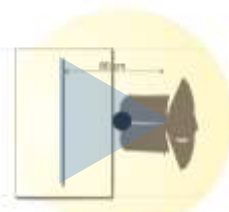
The research used quantitative methods. Research's diagram data was qualitatively analyzed. This research used experiment design and controlled variable of simulation. The experimental design was a layout and crossover design. The controlled variable of simulations was the condition of the main chapel of The Church Of Light. There are 40 users joined the research. The simulation was 3d static image and Virtual Reality of the main chapel of The Church Of Light.

III.2 Research Design

The instrument to calculate telepresence was a questionnaire as semantic differential by Osgood. (Osgood, Suci, & Tannenbaum, 1957). The questionnaire studied from the literature study of main chapel of The Church Of Light.

Table 3. 1. Research Variable
Source: Hendro (2014)

Variable	Sub Variable	Parameter	Indicator	Questionnaire Word
<i>Telepresence (mediated perception)</i> Telepresence defined as someone experience of existence to the environment through a medium Gibson (1986) in (Steuer, 1993)	Vividness Vividness defined as the quality of the image. Gibson (1986) in. (Steuer, 1993)	Depth Quality of data that transferred to simulate the virtual environment such as resolution and sharpness.	Darkness	<i>Dark – Bright</i>
				<i>Glare – Non Glare</i>
				<i>Hazy - Clear</i>
				<i>Dull – Bright (clear)</i>
			Small in dimension (113m ²)	<i>Spacious– Narrow (cramped)</i>
				<i>Large – Small</i>
				<i>Wide – Narrow</i>
				<i>Deep – Shallow</i>
			Dimension ratio 1:3:1	<i>Proportional – Not Proportional</i>
				<i>Levitate – Demote</i>
				<i>Chaotic – Ordered</i>
				<i>Symmetry – Asymmetry</i>
		Monochrome	<i>Colorful – Colorless</i>	
			<i>Warm – Cool</i>	
			<i>Interesting – Monotonous</i>	
			<i>Uniform – Non Uniform</i>	
		Breadth How many human sensors that could be manipulated, usually limited in sight and hearing.	Clean, quiet and calm interior space	<i>Clean – Dirty</i>
				<i>Tense – Relaxed</i>
<i>Quiet – Crowded</i>				
<i>Excitable – Calming</i>				
Closed		<i>Open – Enclosed</i>		
		<i>Loose – Tight</i>		

			spaces	<i>Public – Intimate</i> <i>Rounded – Angular</i>
			Empty spaces (emptiness)	<i>Public – Private</i> <i>Empty – Crowded</i> <i>Blankness – Fullness</i> <i>Unpleasant – Pleasant</i>
			Spiritual and dramatic feelings	<i>Distraction – Focus</i> <i>Somber – Cheerful</i> <i>Joy – Dramatic</i> <i>Spiritual – Irreligious</i>
			Detail of object	<i>Complicated – Simple</i> <i>Artificial – Natural</i> <i>Bumpy – Plain</i> <i>Rough – Smooth</i>
	Interactivity Interactivity defined as user's degree in communication process. Users have control and capability to the role exchange	<i>Speed of interaction, or response time</i> (Steuer, 1993)	Simulation and experiment	
		<i>Range</i> (Steuer, 1993)	Simulation and experiment	
		<i>Mapping</i> (Steuer, 1993)	Simulation and experiment	visual, haptic, dan hearing
Notes: the red words are the right spatial perception of the main chapel of The Church Of Light				

FINDINGS AND DISCUSSION

IV.1 Findings

The research began with creating a simulation of main chapel of The Church Of Light using SketchUp and Unity3D. The graphic simulation was 5 3d static image. Unity3D used to make the VR simulation. The VR simulation used a Head Mounted Display and a gamepad.



Figure 4. 1. Simulation Using SketchUp and Unity 3D

Source : Hendro (2014)

The research held on Department of Architecture and Planning of Gadjah Mada University and Jogja Digital Valley. There are 40 users joined the simulation.



Figure 4. 2. VR Simulation in UGM and Jogja Digital Valley

Source : Documentation (2015)

IV.2 Discussion

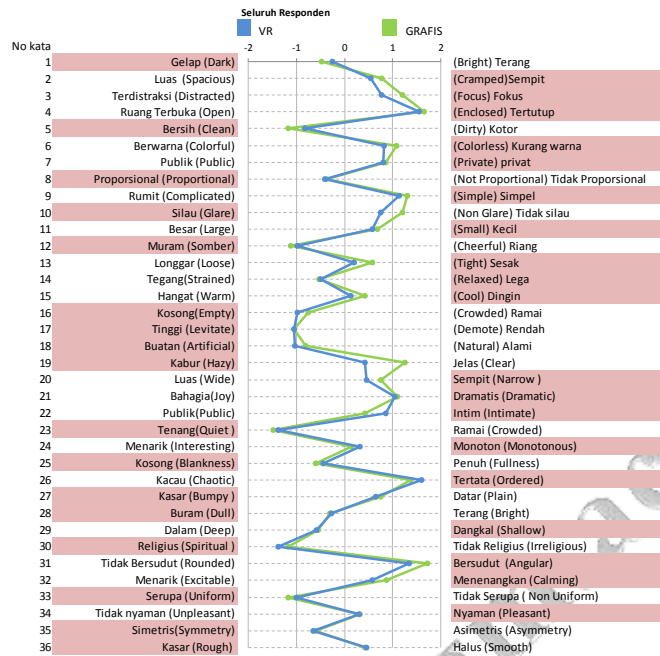


Figure 4.3. The Mean Analysis of VR and Graphic
Source: Hendro (2015)

Research concluded there was no significant mean differences between graphics and Virtual Reality. The spatial perception of the main chapel at The Church Of Light can be represented from both mediums. Moreover, the study showed there are 2 group of perception that unmatch with literature study. There was similar case from (Billger, Haldal, Stahre, & Renstrom, 2004). They focused on the color and space perception from real room and virtual room. They criticized about the utilization of a computer simulation was to create a fancy and nice image without calculating the right condition. The method was comparing simulation product using 3 computer application. They design a questionnaire to calculate the differences. They found there was a significant different between real room and virtual room, there was mismatch of reflection of the surface also low color variation and shadow gradation. Moreover, the white colour was difficult to be simulated. It caused the unreal contrast effect and affect the spatial perception.

Table 4. 1. The Analysis of Graphic and VR
Source: Hendro (2015)

No	Words	Peception	Mean		Keterangan
			Graphic	VR	
10	Silau (glare) – (non glare) tidak silau	<i>Darkness</i>	1.20	0.75	Same direction but wrong spatial perception
19	Kabur (hazy) – (clear) jelas	<i>Darkness</i>	1.25	0.43	
14	Tegang (strained) – (relaxed) lega	<i>Clean, quiet and calm interior space</i>	-0.53	- 0.50	
29	Dalam (deep) – (shallow) dangkal	<i>Small in dimension (113m2)</i>	-0.55	- 0.58	
27	Kasar (bumpy) – (plain) datar	<i>Detail of object</i>	0.75	0.65	
36	Kasar (rough) – (smooth) halus	<i>Detail of object</i>	0.43	0.45	
C Notes: the red words are the right spatial perception of the main chapel of The Church Of Light					

The detail of spatial perception of the main chapel of The Church Of Light disclosed by (Gill, 2006) and (Ratkovic, 2012), they argued there was a duality of perception, a dark small room with cross shape void. There are many powerful impressions when the light through it, the perception such as natural – artificial, dark – bright, and stark – serene. The duality of perception explained by Ando. He wanted to create a room with duality concept, relation between architecture and nature, dark – bright, artificial – natural, and effort to bring the spiritual sense. An Ando's work critic and photographer, (Soni, 2010) and (Pare, 1997), said that Ando's work like a poem, play emotional feelings thorough light and dark to bring the form, presents a variety of spatial perception and imagination.

There was a contrast to the results found by (Koramaz & Gulersoy, 2009), the research comparing a visualization medium with 55 users from master student of architecture. They comparing VR application with 3d static image for represent Zeyrek as the historical region. A similar research conducted by (Schaik, 2010). Schaik comparing the 3d static and VR application for outdoor visualization. The research concluded that there was a differences and big potential for VR to be used in the outdoor visualization. The allegation with this research was on the research object. The object was an outdoor and historial region. It was presumably because VR capable to represent the outdoor object with better control variable such as *sight, sound, smell, touch, taste*.

CONCLUSION AND SUGGESTION

V.1 Conclusion

Research concludes there was no significant mean differences between graphics and Virtual Reality. The spatial perception of the main chapel at The Church Of Light can be represented from both mediums. According to 7 perception category that be represented, graphics and Virtual Reality can be categorized as an effective medium. Moreover, analyze results to 2 perception category that not in accordance with real condition, specifically to the darkness and detail of the object. This could happen because of lack of quality in simulation product. The lack produced from the low contrast effect and unmatched material reflection or miss match with real condition.

V.2 Suggestion

Suggestion for another researcher is preparing a good research design. Especially is the experimental design and the selection of research subjects. The unprepared of research subject leads to poor outcome.

Technical difficulties during the research is on simulation phase such as tools preparation and the process of making simulation using the software. This research opens the opportunity for researcher in architecture, specifically in architectural visualization, perception through medium, and human-computer interaction. The other focus and methods are Virtual Reality as a simulation such as analyse the light and color quality, the utilize of VR for revitalize the cultural heritage buildings, and presentation of ideas and concepts.

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