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Virtual Reality 3D Media of Royal Temples in Thailand: Case Study of Wat Yannasangvararam Woramahavihan

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Abstract

The objectives of this research were to (1) development of virtual reality 3D media of royal temple in Thailand: Wat Yannasangvararam Woramahavihan, (2) study the quality of virtual reality 3D media by 5 experts, (3) study the efficiency of virtual reality 3D media by using formula E_1/E_2, by 50 students and (4) study the satisfaction from 50 students who have seen the developed virtual reality 3D media. Thailand had many invaluably cultural heritages found in various areas, particularly historical heritage, arts, architecture, and the way of life, which attract tourism in Thailand at the present. This research was to distribute knowledge about Thailand's cultural heritage and develop a model representing historical places in the form of virtual reality 3D computer graphic model with 3D environmental condition. The 3D computer graphic processes were as follows: (1) Pre-Production: problem defines and studies, drawing maps, determined walking zone in the temple, (2) Production: 3D model character, shading and texturing, light and shadow, rendering and interactive and (3) Post-Production: research validation by experts. The virtual reality 3D computer graphic model presented in both Thai and English language, which was compatible with personal computer can lead to further education for students, undergraduates and people and conserve Thai culture. The results of this research were as follows: (1) there was a good level ($\overline{X}$ = 4.29, SD = 0.62) of the quality of the virtual reality 3D media, (2) the efficacy of the virtual reality 3D media was 81.79/80.64 which was higher than the defined criteria 80/80 and (3) there was a good level of satisfaction ($\overline{X}$ = 4.20, SD = 0.42) in using the virtual reality 3D media.

Keywords: Virtual reality, 3D media, Royal temple, Thailand, Wat Yannasangvararam Woramahavihan

1. Introduction

Thailand has value cultural heritages which are very various all over the country. Especially, the heritages of historical, arts, architectural, and lifestyle are the prominent point of tourism in Thailand. (Royal Temple, 2013) Chonburi province is located in the east of Thailand. Chonburi province has very long history and also is the center of transportation, industry, tourism, and some significant traditional cultures such as Buffalo Racing Festival. In addition, this province has the important historic sites of religion which is the temple where it is the place of Buddhists to trust in. One of the temples is Wat Yannasangvararam Woramahavihan in which the King Rama IX had given as the highest rank of royal temple in the type of Woramahavihan for only one in the province. This temple has very long biography of Lord Buddha located in Bang La Mung district, Chonburi province. The King had faith so that he gave this temple as Royal Patronage. The area near the temple is constructed several of the royal projects such as reservoir for the convenient of irrigation around the temple and become beneficial for people and

monks in that area, the training center for young farmer, and the project of afforest to bring the animals and richness back as the past. However, the worth heritages are not interested and ever used it in education such as the acknowledgement of the profundity of folk wisdom which stays in the cultural heritages as it used to be. (Bootchuy, 2005) (Chutithamo, 2014) (Wat Yannasangwararam Woramahavihan Homepage, 2016) Nowadays, the Virtual Reality Technology is used in building the materials to be virtual reality by using 3D program to make the audients feel along with the stuff and create the learning process from one which similar to the real place. The audients will be able to acknowledge and remember the information which is very closely to reality. (Wiengsong, Kayapart & Arreerard, 2010) Therefore, the research sees the significant of passing on knowledge, preserving the religion and Thai traditional so that the author creates the virtual reality 3D media about the royal temple in Thailand, Wat Yannasangvararam Woramahavihan, in virtual reality 3D computer graphic.

2. Objectives

2.1 To develop virtual reality 3D media of the royal temple in Thailand. In this case, the royal temple is Wat Yannasangwararam Woramahavihan.

2.2 To study the quality of virtual reality 3D media, by 5 experts.

2.3 To study the efficiency of virtual reality 3D media by using formula E_1/E_2, by 50 students.

2.4 To study the satisfaction from 50 students who have seen the developed virtual reality 3D media.

3. Literature Review

The order of royal temple is started from the King Rama V, the King Vajiravudh. In 1942, the King had ordered to classify the levels of royal temple into 3 levels which consist of elementary level, secondary level, and advance level. Each level will be classified even more and have the different words at the end of temple's name as table 1

Table 1. Shows the levels of royal temple

Levels	Ravoramaha vihan	Ratchavorav ihan	Woramaha vihan	Woravihan	No word includes
Advance	√	√	√	-	-
Secondary	√	√	√	√	-
Elementary	-	√	-	√	√

Wat Yannasangworaram Woramahavihan is the advance level of royal temple in the type of Woramahavihan located in Ban Huai Yai, Huai Yai sub-district, Bang La Mung district, Chonburi province, 20260 and build in 1976. Somdet Phra Nyanasamvara Somdet Phra Sangharaj wondered to have his name to be the name of temple. Thus, the temple name is "Wat Yannasangworaram Woramahavihan". The total area of the temple is 366 rai 2 ngan 11 square wa which is not include the area from royal project of King Rama IX for 2,500 rai and divided into 4 areas (Anonymous, 2015) such as (1) Buddhist

shrine area. It is a very important area of temple like the core of the temple. This area consists of many religious places such as The Replica Buddhagaya Chedi, The pavilion of Somdet Phra Srinagarindra Boromarajajonani Pavilion, The pavilion of Princess Sirindhorn, Phra Ubosot Hall, Ariyakarn museum, Phra Boromthat Chedi Maha Chakripipat, The MorWorKor SorThor Pavilion, Phra Sri Ariya Metteyya Vihara, and Phra Maha Mondop Phuttabat PhorPorRor SorKor. (2) It is the location of parsonage and the palace for Supreme Patriarch (of Thai Buddhism) (3) Layman area. This is the place for layman and laywomen and also for the people who come to meditate. (4) The royal project area.

The media which is popular to use is 3D. It is the mathematical process to create the model by using wireframe to demonstrate it into 3D including the 3D motion and none motion. It can also demonstrate in renderer process by presenting in 3D. In this research, the analysis of Wat Yannasangworaram Woramahavihan model created from virtual reality 3D in many areas is used the desktop VR which is the virtual reality system presented through the desktop of the computer and used some computer's techniques. (Taxén & Naeve 2002) (TECFA Homepage, 2018) The user can interact with virtual reality 3D as same as using mouse or keyboard on computer.

4. Research Methodology

Data procedures in this research can divide into 3 periods.

The first period: the data analysis, the author has collected all related theory, scope, and possibility in developing media and also has studied the media creation in order to use it as the information in this research to present it to the Asian Conference on Education 2013 in October 23-27, 2013 at Osaka, Japan. The topic of 3D Virtual Environments of Royal Temple in Thailand (Wat Yannasangvararam) Phase 1 is supported by Sripatum University-Chonburi Campus. The author received the advices from the professional committee and the participants in the conference and took some issues about the form of interaction, the environment of installing media, and new technology to develop this research in next procedure. (Khongpit, 2013)

The second period: the development of virtual reality 3D media, the development of virtual reality 3D media consists of 3 main processes which are (1) Pre-Production, (2) Production and (3) Post-Production that include the detail as follow: (Leeaumnoichoke, 2007)

(1) Pre-Production after studying the details from historical resources, it found that the collection data is impossible to do because this temple have very long history and some details are myth or story which unable to prove whether it true or not. Some places are not allowed people to visit because it is in the Buddhist shrine area and become deteriorate. The author has requested to collect data and interview Buddhist priest Thannasead Chutithamo to collect information and pictures around temple. The author has analyzed and synthesize the information with other believable resources before leading to the next procedure. The process of creating diagram and determining the scope and direction inside the temple to develop into virtual reality 3D media.

(2) Production the process of taking the picture from real location of the temple in the front, picture turntable, and every texture of the temple such as the wall or the floor. The creation of model consists of these procedure as follow: Using the picture turntable to create the model so that the size will not wrong from the reality. Creating 3D model by using the Autodesk MAYA program to build the shape which consists of 3 materials:

Polygon, NURBS, and Sub-division Surface. The author chose the Polygon to create the 3D model because it is more suitable to build the shape of religious place. In Fig. 1**.**

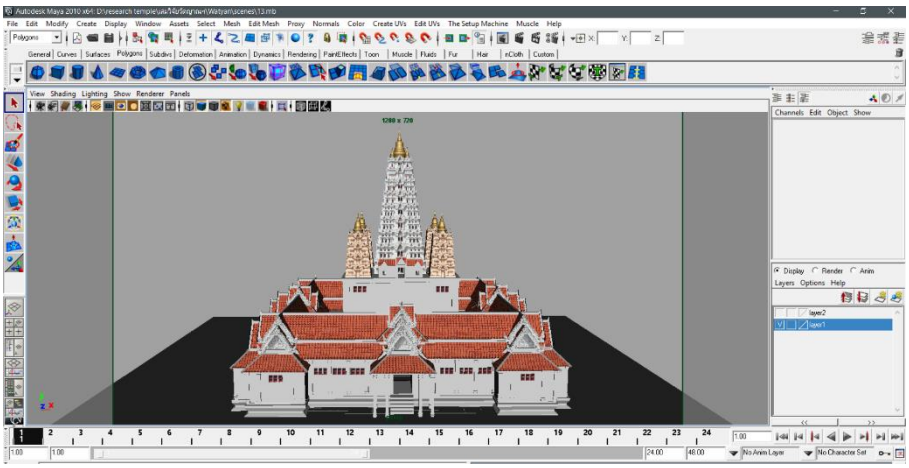

Fig. 1. Autodesk MAYA program

Creating the UV Mapping which is the transformation from 3D to 2D by separating the piece of picture so that it can be painted in Adobe Photoshop in order to get the realistic colors and textures. Bringing the pieces of picture to paint the textures and colors to the model. Determining the light and shadow which is incident to the religious place to be natural and creating the model from renderer of Paint Effects or Effects of the shape, texture, and light by using Maya Software Renderer on Mental Ray to get more realistic of the pictures, but it might take some times longer than other renderer such as Maya Software, Maya Hardware, and Maya Vector. (Kunkhet Homepage, 2016) The author has chosen the Unity program for creating the interactive of user because the Game Engine is supported 3D picture, multiplatform, and open source by creating the directions which user can use the mouse and keyboard to control it to view it freely. It will show the coordinate of the directions in mini map including the sound and subtitle in both Thai and English. In Fig. 2.

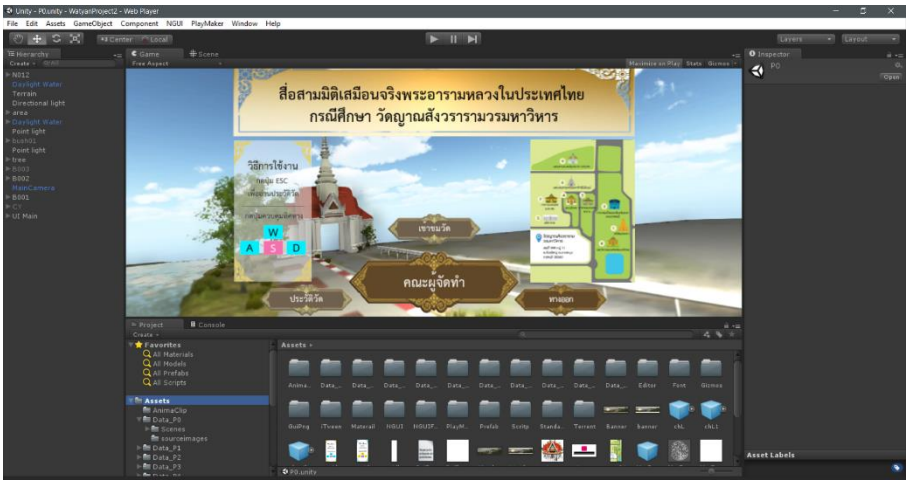

Fig. 2. Unity program

(3) Post-Production the checking of the virtual reality 3D media is in this process. It is evaluated the quality of this 3D of Wat Yannasanvararam Woramahavihan by 5 experts. The presentation of virtual reality 3D media is showed in Software Expo Asia: Digital Integration on January 21-23, 2016 at Queen Sirikit National Convention Center to observe the interaction of people to the media and receive the comments from general people in order to develop the media to be more complete. Also, it got the attention from many people.

The third period: testing process the test is on high school student from for 50 students at Piboonbumpen Demonstration School. They are 12-15 years old and study Social studies subject. The teacher will use this media on instruction for 1 learning unit which contain other 3 units which is (1) the royal temple, (2) the historical of Wat Yannasanwararam Woramahavihan, and (3) the religious places in the temple.

5. The Results

5.1 The result of the development of virtual reality 3D media as follow:

In Fig. 3, the map of Wat Yannasangwararam Woramahavihan divided into 9 places (1) The Replica Buddhagaya Chedi, (2) The pavilion of Somdet Phra Srinagarindra Boromarajajonani Pavilion, (3) The pavilion of Princess Sirindhorn, (4) Phra Ubosot Hall, (5) Ariyakarn museum, (6) Phra Boromthat Chedi Maha Chakripipat, (7) The MorWorKor SorThor Pavilion, (8) Phra Sri Ariya Metteyya Vihara, and (9) Phra Maha Mondop Phuttabat PhorPorRor SorKor. (Wat Yannasangwararam Woramahavihan Homepage, 2016)



Fig. 3. The map of Wat Yannasangwararam Woramahavihan

In Fig. 4, the Replica Buddhagaya Chedi, This replica stupa was built to fulfill His Holiness Somdet Phra Nyanasamvara's desire to have a commemorative structure constructed for the Lord Buddha in this monastery. M.R.Mitrarun Kasemsri's design was adapted from the original Buddhagaya Chedi in India. The replica Buddhagaya Chedi is a symmetrically square structure with a width of 22.50 meters on all sides. It is enclosed by Phra Rabieng (cloisters) and Kampaengkaew (boundary walls) and surrounded by flower gardens of geometrical patterns. The principal stupa is seven-storey tall with a floor-to-floor height of 3 meters and a width of 12 meters across the base. If the two levels at the stupa's base are included, the stupa will be nine-storey tall. There is a spiral stairway leading to the top floor. A permanent exhibition on the topic of 'What did Buddha discover from his enlightenment?' is displayed along the exterior veranda and the interior walls of the principal stupa on the ground level.



Fig. 4. The Replica Buddhagaya Chedi

In Fig. 5, the pavilion of Somdet Phra Srinagarindra Boromarajajonani Pavilion, Her Royal Highness the Princess Mother Hall is a three-story multi-purpose hall. It was built to offer to the Princess Mother on the auspicious occasion of her 90th Birthday Anniversary in 1990.



Fig. 5. The Pavilion of Somdet Phra Srinagarindra Boromarajajonani Pavilion

In Fig. 6, The Pavilion of Princess Sirindhorn, Hall of Great Merits (SW. GW.) is a concrete building with reinforced metal structure, 17 meters wide, 31 meters long. The hall was constructed to offer to Her Royal Highness Princess the Queen Mother. Her Royal Highness Princess Galyani Vadhana, the Princess of Naradhiwas attended the foundation stone placing ceremony on April 6th, 1983. The Hall is used as a venue where visitors to the temple can offer foods and goods to the monks and novices residing at the temple. There is also a Buddha statue with A.P.R. M.O.monogram of the late king, His Majesty the King Anandha Mahidol or King Rama VIII of the Chakkri Dynasty and His Royal Highness Prince Mahidol Adulyadej, the Prince of Songkhla, the Prince Father placed inside this hall as well. The King Rama IX granted the royal permission to the temple to have A.P.R. monogram of King Rama VIII, and M.O. monogram of His Royal Highness the Prince Father placed at the Buddha statue as "A.P.R. M.O." The Buddha statue is in meditative posture, like the PPR Buddha. The lap length is approximately 3 meters. The King Rama IX attended in the casting ceremony of the statue on August 10, 1983 at the percent outside Khana Rangsi Ubosot, Bawornnivetwiharn Temple.

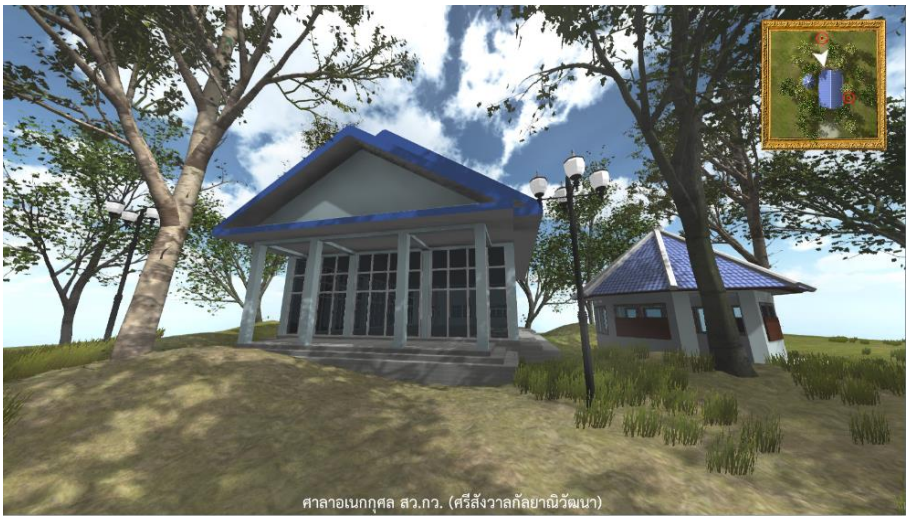

Fig. 6. The Pavilion of Princess Sirindhorn

In Fig. 7, Phra Ubosot Hall, the main temple of worship is a concrete building with metal structure. The building itself is 13.30 meters wide, 21 meters long. The architecture of the building is mostly that of Chinese influence, with Chinese-styled roof made of shiny glazed tiles and stucco tympanum.



Fig. 7. Phra Ubosot Hall

In Fig. 8, Ariyakarn Museum, this building, designed by Khun Sanit and Khun Preeya Chimchom, is situated to the left of Phra Pokklao Ariyakhet. In the middle of the building's main room is a Buddha image, flanked on both sides by fiberglass figures of Thailand's 22 holy monks and 2 laywomen of great eminence.



Fig. 8. Ariyakarn Museum

In Fig. 9, the name of the Phra Boromthat Chedi Maha Chakripipat means "the pagoda containing the relics of Buddha for the prosperity and greatness of the Chakkri Dynasty." The Great Chakkri Pipat Pagoda was built to honor His Majesty King Rama I and the Chakkri Dynasty. The base of the pagoda is 33 meters wide, with the height of about 39 meters. The construction of the pagoda was commenced on February 16, 1981.



Fig. 9. Phra Boromthat Chedi Maha Chakripipat

In Fig. 10, the MorWorKor SorThor Pavilion is 17.40 meters wide, 21 meters long. It is also a two-story concrete building with reinforced metal structure. The lower level is divided into three parts. The first part is used as storage. The second part under the statue of "Pairee Pinat Buddha" is an area for clean water tanks for daily us-age and consumption. The third room on this floor in used for religious study and also functions as the temple's library. The floor on the upper floor is made from Thai marble stones. This floor is where the Piree Pinat Buddha statue is displayed. It is also used for evening praying and group meditation. The hall was built to offer to the King attended the foundation stone placing ceremony on May 7th, 1984.



Fig. 10. The MorWorKor SorThor Pavilion

In Fig. 11, the temple of Phra Sri Ariya Metteyya Vihara (the greatest form of Buddha's reincarnation) is a reinforced metal structure concrete building, with four gable ends. The roof is made of glazed tiled. The temple is built in the fashion of true traditional Thai architecture very delicate and painstakingly detailed. Inside of the temple is a brass meditating Buddha statue commonly known as "Sri Ariya Meitreya Buddha" The King Rama IX received the statue from the commissioners of the temple and ordered the statue to be placed inside this very temple.



Fig. 11. Phra Sri Ariya Metteyya Vihara

In Fig. 12, Phra Maha Mondop Phuttabat PhorPorRor SorKor has width of 9.00 meters and height of 33 meters. The King Rama IX and her Majesty the Queen granted the royal permission for the temple in using the royal monogram P.P.R. (Por Por Ror) and S.G. (Sor Gor) to be enshrined here. The Great Pavilion of Buddha's footprint was ordered to be built on the top of a hill. The building is a two-story building made with reinforced metal structure. The ground floor is divided into two parts where one functions as a living quarter for the monks in residence and the other is filled with water tanks to keep clean water for daily usage and consumption. The upper floor of the Great Pavilion is where the stone of Buddha's footprints is enshrined. The pavilion is adorned from top to bottom with gold mosaic tiles given by Her Royal Highness Princess Maha Chakkri Sirindhorn. The tiles were once used to adorn the great pagoda at the Grand Temple of the Emerald Buddha in central Bangkok. The flooring of the pavilion is made of Thai granite stones. The glass wall is made from white washed stone. The great staircases of 200 steps are decorated with "Naka" stucco, decorated with glazed white tiles. The steps themselves are made of granite stones. There are two Thai-styled halls at bottom of the grand Naka staircase. These halls are installed with two great Buddha statues. The area from the bottom of the hill to the base of the pavilion is 35 rai (approximately 14 acres). It was specifically suggested that this area were to remain as it is, that it should be preserve in its original natural condition.



Fig. 12. Phra Maha Mondop Phuttabat PhorPorRor SorKor

In Fig. 13, history of Wat Yannasangwararam Woramahavihan divided into 4 areas such as Buddhist shrine area, Parsonage and the palace for Supreme Patriarch, Layman area and Royal project area.



Fig. 13. History of Wat Yannasangwararam Woramahavihan

In Fig. 14, the point of change map in virtual reality divided into mini map.



Fig. 14. The point of Change map

5.2 The result from evaluating quality of virtual reality 3D media in Table 2.

Table 2. Shows the result of quality evaluation of virtual reality 3D media

Aspects	$\bar{X}$	SD	Level
1. Contents	4.36	0.66	Good
2. Creative and design	4.36	0.49	Good
3. Interactions	4.32	0.78	Good
4. Sound	4.00	0.68	Good
5. Aesthetics	4.32	0.56	Good
6. Usability	4.36	0.53	Good
Mean	4.29	0.62	Good

Table 2, the result of quality evaluation of virtual reality 3D media is evaluated from the experts. Mean ($\bar{X}$) of every part is 4.29, and the standard deviation (SD) of every part is 0.62 in good level.

5.3 The result of efficiency evaluation of virtual reality 3D media. The efficiency of virtual reality 3D media that test in the instruction of high school student for 50 persons gets the score by using formula E_1/E_2 which is 81.79/80.64. These scores are also higher than the criteria 80/80.

5.4 The result of satisfaction from the 50 students in Table 3.

Table 3. Shows the result of satisfaction from the 50 students

Aspects	$\bar{X}$	SD	Level
1. Contents	4.39	0.42	Good
2. Animation	4.36	0.46	Good
3. Sound	3.67	0.38	Good
4. Interactions	4.06	0.47	Good
5. Usability	4.52	0.38	Very Good
Mean	4.20	0.42	Good

Table 3, the result of satisfaction from the 50 students toward the virtual reality 3D media. Mean ($\bar{X}$) of every part is 4.20, and the standard deviation (SD) of every part is 0.42 in good level.

6. Conclusions

This research emphasize on the development of virtual reality of 3D media on the royal temple in Thailand (Wat Yannasangwararam Woramahavihan). This temple is very important and famous. In order to transmit the knowledge to local people and tourist, the author has asked for the permission on collecting data and interviewing Buddhist priest Thannasead Chutithamo who is the advisor of this research. After collecting data and pictures, analyzing, and synthesizing with other believable resources, it led to the 3D creation process on computer to make it interactive by using the theory of motion, technique of panning camera, and the control the media from mouse and keyboard also including the subtitle in both Thai and English, and sound thorough the viewing so that it can make audient learn freely.

Due to the study on quality of the media, the author has consulted with the experts who have the teaching experiences at least 5 years in the field of animation, computer graphic, and instruction. During the processes, the author found that the level of suggestions from the experts is in the good level which means that it can be usable and presented to transmit the knowledge to Thai people and foreigners about the beauty, historical, local knowledges, and also stimulate the tourism in Chonburi province. This research is related to the research from Bell and Fogler (Bell & Fogler, 2007) which also used the virtual reality as a tool in education. The learning system of virtual reality can be learned through computer. The learners will see the virtual reality classroom and tool for study.

Due to the study on the efficiency of using this 3D media, it found that the efficiency is higher than the criteria 80/80. It means that teachers are able to use this media on their teaching because this media is very proper and easy to understand (Educ Homepage, 2018) such as the subject of social, history, and tourism. General people are also able to use to gain more additional knowledge which is related to Szalavári, Schmalstieg, Fuhrmann and Gervautz (Szalavári, Schmalstieg, Fuhrmann & Gervautz, 1998). The author has developed the educational tool as virtual reality and then evaluate and test it. It found that the use of this system affects positively on learners in both learning process and the result from studying.

Due to the study of satisfaction from students after viewing the 3D media, it found that the level of satisfaction from 50 students is in the good level. From observation, students tend to like the media for their learning rather than the class which has only

instruction. They prefer the animation media more than the still pictures. The students are also stimulated by the interaction between the media and learners. (Tiantong, 2013)

7. Recommendations

7.1 It should be developed the virtual reality 3D media to demonstrate on other electronic such as mobile phone so that is can increase a number of audients.

7.2 This media should be developed by using Augmented Reality in order to cooperate the virtual reality along with the reality so that it will make more interaction between media and audients and become more interesting.

7.3 The limitation of using this media should be used with the high quality of desktop on computer to show the virtual reality and manage the environment to suit with the media which some temples or school might not be able to manage it.

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