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Applying Augmented Reality to Represent the New Theory of Agriculture "Sa-rae Athitaya"

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Abstract

This research aims to develop Augmented Reality (AR) to represent information regarding the Agricultural Project for Aditayathorn Rice Field and evaluate the user satisfaction towards the AR application. The research participants are those people who travel to the agricultural project site where a sample group of 400 people is selected using convenience sampling. The research tools are based on AR and statistical evaluation techniques. The research data was collected from July to August 2020 and analysed using mean and standard deviations. The results showed that AR was capable of representing information about the project in eleven 3D models. The models can be represented and accessed through different applications (i.e., Android, iOS, and web browser) with background music. The project information can be displayed in the form of text on 3D scenes, which can be performed through cartoons and 3D animations with music and sound effects. The survey results also indicated that the participants were able to learn information of the project more conveniently and quickly. The participants also rated the project with high scores in terms of novelty in learning and interesting information representation.

Keywords: 3D Animation; Agriculture; Augmented Reality; Surin Agricultural Project

1. Introduction

Sa-rae Athitaya is a project based on a new theory of agriculture located in Surin Province, Thailand. This project is among special projects of Her Royal Highness Princess Aditayathornkitikhun. The princess intended this project to be an agricultural learning center under the supervision of "Aditayathorn Agricultural Project". Sa-rae Athitaya is a source of knowledge, technology, and innovation which expected to be useful for Thai farmers. The royal initiative, the philosophy of the sufficiency economy, which has been applied and the working principle of "One Stop Service" in His Majesty the late King Bhumibol Adulyadej focus on the development of older farmers and produce a new generation of farmers to become the Smart Farmer. In the area, the project has been designed to be a space for learning activities and to transfer academic agriculture according to the philosophy of sufficiency economy as well as to develop a natural leisure and tourism place for communities and nearby areas to be mutual benefit with cooperation from government agencies, folk philosopher, and the private sector in the area and from the government. [1]

Aditayathorn Agricultural Project applies information transmission in the form of exhibitions. There are demonstrations of agricultural activities which have been created by the center are interesting and provide new knowledge about agriculture that will benefit farmers, students or

interested persons further. However, the problem of Aditayathorn Agricultural Project is that the place is known in a narrow circle and the number of individuals who pay attention is small. It is also due to the lack of attractive public relations model, lack of novelty in presenting information to meet the needs of news recipients. The public relations by documents or posters alone may not be comprehensive. The conveyed knowledge is in the form of an education sign that is lack of interest and novelty in presenting information. Moreover, when visiting the actual place, there is no information to read and no information to explain the history or knowledge of each place as well. These problems cause those who are interested to not earn any useful knowledge. As a result, the center activities do not achieve the goals.

From the above problems, the researchers therefore have the concept of applying AR to represent information about the project as it could facilitate new learning experience, which causes the information representation more interesting and faster. A wider distribution of information in the form of a 3D image can also allow users to gain new knowledge. Besided, a comprehensive knowledge center of agriculture in the form of digital media provides more learning ways. This is to enhance the learning for quality farmers, people who are interested and from having to learn just in the actual place, the people will be able to study and learn by themselves from anywhere and anytime. This development worked as a prototype of knowledge which transfers through technology in order to provide knowledge and develop agriculture to be sustainable innovative agriculture. As such, the research objectives are: 1) to develop Augmented Reality technology to represent the information of Aditayathorn agricultural project activities; and 2) to study the user satisfaction towards AR application.

2. Materials and Methods

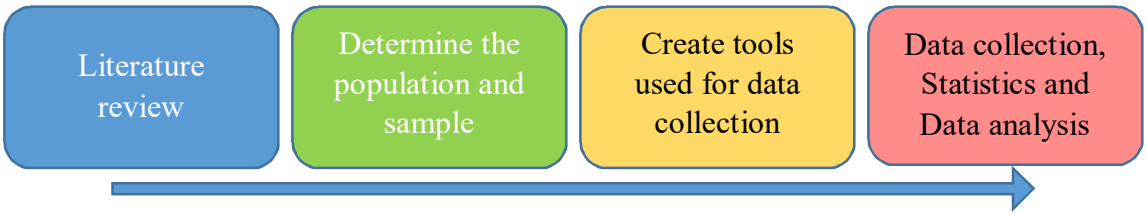

Fig. 1 Research process

Literature review

Ganji et al. use of Augmented Reality:AR helps to display the information of geography including to show various masses on the world. Such technology helps the data viewer to see more dynamic image that overlays with the actual viewing environment. The user can perceive information about geography and interact with the resulting objects such as information about the weather of that area or temperatures above the sea level, etc. This quality causes the user to be able to learn and understand the context of the environment better [2]. Yin et al. development of an application to present the story of the World Heritage Site with technology of Augmented Reality: AR, aims to study the demand of tourists in the use of application and to allow tourists to take part in expressing their opinions in order to be used in the development of application to meet the needs of tourists in the future. The place of study is the World Heritage Site of Macao. A sample of 50 people is used as tourists who traveled to the location. The study found that the application was more effective for Asian tourists than Europeans. This helps tourists to gain more travel experiences and interact with the attractions [3]. Saragih and Suyoto presents an application which provides travelling experience using Augmented Reality technology during the COVID-1 9 outbreak. The tourism information is provided including tourist maps in the aforementioned island. The target group of this research is foreign tourists and local tourists. The result of the study found that the developed application could be a prototype for the

new type of tourism in which tourists can perceive the tourist attractions in the form of a 3D object [4]. Quintana et al. studies in 3 areas: 1) Whether Augmented Reality technology affects learning achievement or not; 2) Whether learners will be able to memorize the knowledge which they have studied for a long period of time or not; 3) Whether this technology helps motivate the learners or not. The study is analyzed from a sample of 60 people using the content in the chemistry course and the application that is used for testing is the AR VR Molecules Editor. The results of the study showed that the sample group had an immediate increase in academic performance in terms of content memorization which the sample had different memory periods for each person. This research shows that Augmented Reality technology simplifies the understanding of content for learners and helps them to be interested in studying content of the lesson. [5]

Determine the population and sample

People who visit the Aditayathorn Agricultural Project area are the population which cannot be determined the amount, the Cochran [6] formula is used to calculate the sample size equaling to 400 people who were selected by using a convenient sampling method.

Create tools used for data collection

The development tools are divided into 2 components: 1) The development of Augmented Reality technology 2) the questionnaire of system usage satisfaction.

Components 1: The development of Augmented Reality technology by using the concept of SDLC model information system development consists of 7 steps to be implied as follows:

Step 1: Enterprise problem searching is the process of gathering information of the agency to be able to identify problems and solutions for the system development. This research uses two types of data collection: 1) Primary Data is the tool used for data collection which is an open-ended questionnaire. The questionnaires are proceeded by interviewing experts including project leaders and project staff of 10 people about the project history, activities that are operated within the project and information from the tourist questionnaires about perception of information presented by the agency, perception of information presenting form by the organization and the needs of information perception form of 50 tourists; 2) Secondary data is the data from book study, project documentation, project publicity boards installed to provide knowledge within the project and the information from the travel site.

Step 2: Feasibility study is conducted to assess the feasibility of system development and implementation by conducting studies in 3 areas: 1) Tool technical aspects: at the present, information technology has developed by leaps and bounds, various systems can be developed and maintained more easily and comprehensively which help to access to the internet network that is widely considered as an important factor of system development. Moreover, both of hardware and software devices support in a variety of working formats; 2) Personnel and readiness: as today's software has been developed to be easier to learn and use. It is easy for people in the organization to learn and use new technology which is applied in the organization. Personnel at Aditayathorn Agricultural Project understand the basics of using a mobile phone using a smartphone (Information from inquiry) and; 3) The low cost of developing software information system: the fact that many companies provide free services including program development in the form of Open Source which can be downloaded and installed for free. As a result, the agencies which apply the information system do not have to bear the burden of costs.

Step 3: Analysis: the requirement analysis of overall user revealed that the users required the system that could be used in 2 ways: 1) Presenting travel information through Augmented Reality technology on mobile and; 2) Presenting travel information through a website.

Step 4: The design is divided into 2 parts: 1) Designing of 3D model starts from the character designing stage and the scene designing by using the line drawing to define the character's characteristics such as character's name, clothes and history as shown in Fig. 2, then designing of the character movement style and; 2) Information system designing.

Fig. 2 Design of 3D characters and scenes.

Step 5: Development and test which is from the system design, information development is divided into 2 parts, consisting of: 1) the development of Augmented Reality technology: 3D models are developed with blender programs. It uses images taken from real locations and designed to be lively. The design emphasizes on character of cartoons using polygon as the material in model molding as shown in Fig. 3 and the model coloring so that the object has its surface which is similar to the design pattern as shown in Fig. 4. The 3D model is functioned as an access to the video footage including the content to be able to show in the form of Augmented Reality technology by developing through the Sketchfab platform. As the result, the visualization of 3D models is defined and published and; 2) Website development with PHP language: the development performs by using visual studio code as a web development tool as well as using the My SQL database management system. Using a system test by an expert on the content of Aditayathorn Agricultural Project is divided into 5 areas as follows: 1) The correctness of content; 2) The proper amount of content; 3) Content presentation according to the purpose; 4) The easy-to-understand language for communication and; 5) The interest of presented content. As well as the system which is tested by two experts of information system development, divided into 4 areas: 1) The capabilities that meet the needs of user; 2) The ability to work according to the system function; 3) The convenience and easiness of use and; 4) The system safety.

Step 6: The system installation of Augmented Reality technology is provided via Sketchfab platform as a third-party installation and system installation of the second part which is website development to manage the information of Aditayathorn Agricultural Project. It is installed on the server system of organization that researcher operates by installing the website and database system. Then the website was linked and opened for the service.

Step 7: System maintenance: system usage has been tracked for a year by collecting data through user questionnaires and expressing opinions through the information receiving system. The information is used to modify and develop the system in order to work in accordance with the use of aforementioned period. A manual for the system is provided as well as a training which is about how to use the system for the personnel at Aditayathorn Agricultural Project.

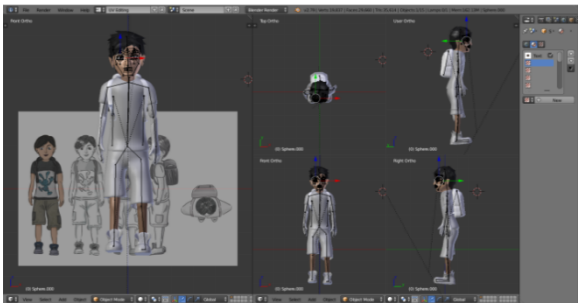

Fig. 3 Model 3D development.

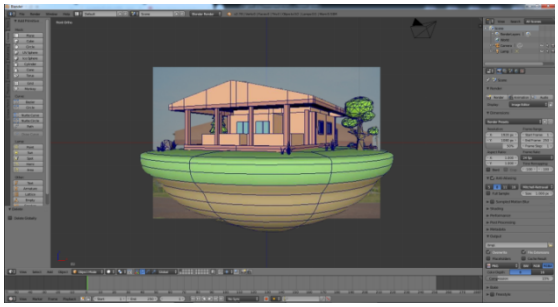

Fig. 4 Adding coloring to a 3D model.

Components 2: Satisfaction in using the system is analyzed with the questionnaires which is divided into 3 parts: Part 1: The general information of respondents is consisted of gender, age, and marital status; Part 2: Satisfaction towards the use of system with Likert Scale [7] of 5 levels with 5 items and; Part 3: Suggestions.

Data collection, Statistics and Data analysis

The research team has collected data themselves by introducing the development system to the tourist who travelled to Aditayathorn Agricultural Project. The system was recommended its usage closely and the respondents did an online questionnaire which was collected as data. The data collection was carried out during July - August 2020.

The statistics used for research data analysis use 2 statistic values for data analysis: 1) mean and; 2) standard deviation. [8]

Data analysis after the period of data collection from July to August 2020 proceeded with 400 respondents (research sample), then were analyzed in 3 parts as follows: 1) General information of the respondents is gender, age, and marital status (qualitative data); 2) Satisfaction with the use of system that the answer is measured by using a Likert Scale measure of 5 levels with 5 items (quantitative data) by using the mean of respondents' satisfaction level on each topic and analyzing standard deviation to examine the tendency of their opinion. This was then shown in the form of a table and the description of analysis results and; 3) Open-ended questions are the nature of the feedback (qualitative data), in this research, it was grouped in which the analysis results would be in descriptive form.

3. Results and Discussion

From the objective of this research, the results of this research could be described in 2 parts as follows:

Part 1: Development of Augmented Reality technology was applied to improve a 3D model with an environment which was similar to Aditayathorn Agricultural Project of 11 bases as shown in Fig. 5. The model was then presented in the form of Augmented Reality technology so that tourists would be able to visit the virtual environment. The user could access various types of content, view details of the attractions in 3D, as well as access content information of all 11 scenes in the Adityadorn Agricultural Project. The elements of presented content included 1. 3D models and; 2. Details of the content in each scene. When the user clicks on the number that appears on the bases, a brief detail about the project will be displayed, with a total of 11 bases as shown in Fig. 6 and 3. The animated 3D video is shown on the YouTube platform provides detailed information on the 11 bases thoroughly by presenting in the form of cartoons, animation, and sound narration. The example is shown in Fig.7. The applied application is Sketchfab which can be displayed on Android and iOS operating systems. It also renders the 3D models through a web browser before arriving at the actual

location as shown in Fig. 8. The public relations of the project were promoted through websites and brochures to enable the tourist to link information in digital formats from multiple.

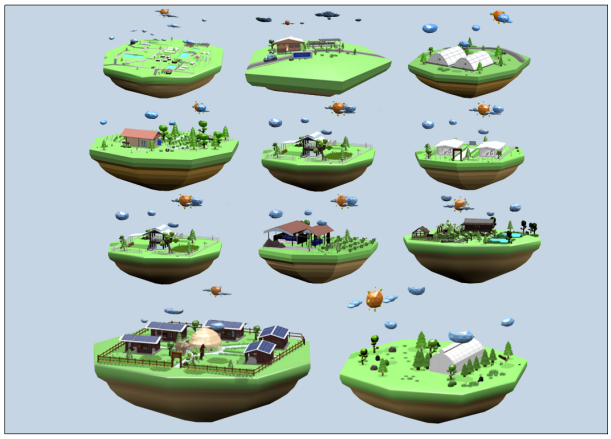

Fig. 5 Development 3D models 11 bases.

Fig. 6 Sketchfab 3d model platforms.

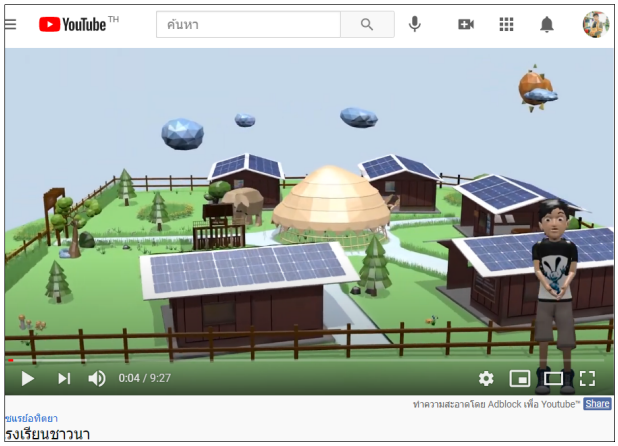

Fig. 7 3D animation on YouTube.

Fig. 8 Results of AR development.

Part 2: User satisfaction study results from the research sample group of 400 respondents with 5 items of questionnaire, which were questionnaires of a 5-order scale, the results were shown in Table 1.

Table 1 The level of user satisfaction of Augmented Reality technology

	Assessment list	$\bar{x}$	*S.D.*	Satisfaction level
1.	Easy to understand the content	4.11	0.83	Satisfied
2.	New interestingness in information presentation	4.04	0.83	Satisfied
3.	Ease of access to information	4.09	0.82	Satisfied
4.	Easy-to-use system	4.04	0.85	Satisfied
5.	The respondent will introduce the system to others.	4.05	0.84	Satisfied
	Average	**4.07**	**0.83**	Satisfied

From the table 1 satisfaction of users towards Augmented Reality technology by conducting a satisfaction study with 5 questions which could be able to meticulous results of each topic as follows:

Assessment Topic 1: User could understand the content easily with a high level of satisfaction due to the information presentation of tourist attractions in the Aditayathorn Agricultural Project (Sa-rae Athitaya) is designed with a focus on the use of 3D picture as a presentation medium, and also includes 3D animated cartoons which benefit on audiences' increasing the information perception. This is in line with the research of [9], using animation media and graphic review as the part of teaching and learning to develop learning achievement in the course of Energy and Environment subject, Structure and Composition of Plants in second year of vocational diploma of Tourism and Hospitality, Phayab College of Technology and Business Administration. The results of the study showed that teaching materials created understanding of students' learning which resulted as higher post-study.

Assessment Topic 2: the new interestingness in information presentation was in the high level of satisfaction. Since information presentation with Augmented Reality technology is the information presentation technique that combines the real world and the virtual world story presentation together. It is a new form of presentation that creates excitement in viewing information which is in line with the research of [10] by developing Augmented Reality technology to showcase Thai wares. The result of research showed that the technology created a novel in terms of presentation. This resulted in a very appropriate level of satisfaction and interest in Thai wares.

Assessment Topic 3: Ease of access to information was in the high level of satisfaction. Since the data can be accessed through a mobile phone with smartphone type which is now widely used, therefore the smartphone is a factor that encourages the user satisfaction in the field of information access. This is in line with the research of [10] by developing Augmented Reality technology for the exhibition of Thai wares. The research results found that users could more easily access museum information.

Assessment Topic 4: Easy-to-use system was in the high level of satisfaction. This is caused by the researcher emphasizing on the simplicity of information presentation, availably accessing information of the Aditayathorn Agricultural Project (Sa-rae Athitaya). It is easy to access by focusing on images, 3D models and symbols as key components of the information presentation. This is in line with the research of [11], which developed an application to promote tourism in 8 must-visit attractions in Phetchabun Province with virtual technology to be Easily used. It found that the tourist satisfaction was in the highest level.

Assessment Topic 5: The topic of "respondent will introduce the system to others" was in the high level of satisfaction. This is because the presentation system of 3D model data using Augmented Reality technology is different from the location information presented in a text-based and photographic format only. Therefore, the introduction of technology presents the information with 3D models in the form of Augmented Reality technology could help supporting and influencing the decision to visit the project again. As well as the tourist would introduce the technology to other users. This is consistent with the research [12] of that promotes tourist attractions in Maha Sarakham Province using virtual technology. The results of research on the topic of Augmented Reality in Maha Sarakham Province (AR Maha Sarakham) caused the tourist to be interested in visiting Maha Sarakham Province. The result was in the high level of satisfaction.

4. Conclusion

This research offers augmented reality technology to support tourism of Agricultural Project Aditayadorn Surin Province by linking tourist information of the project through an online platform. This allows tourists to view in 3D and to access tourist information through smartphones. The tools consist of Blender program, a 3D modeling tool, and Sketchfab, a platform for creating augmented reality technology. The results of research found that it was able to create 3D models of 11 scenes and presented 3D cartoons through YouTube which is the platform that can be used through a web browser and smartphones with Android and iOS operating systems. The system was then tested on a

sample of 400 people. The results of assessing the overall satisfaction in using the system showed that the samples were satisfied at a high level which showed that the presentation of tourism information in this format is the part that encourages tourists to be impressed by the trip and to pass it to the rest of the group. This will result in the number of tourists in the said location to be increased.

5. Suggestions

In terms of utilization, Augmented Reality (AR) is a very innovative and exciting form of information presentation to the viewer. Therefore, it is very suitable for using in tourism promotion or for drawing attention to information perception. This will result in the organization that uses this technology to create a pleasant image and be interesting to the general public. Especially, the tourist attractions are ideal to use in history description and combine content with actual objects to create new travelling experiences. The research found that current factors contributed to the use of Augmented Reality (AR) in a high level, evidenced by the fact that the samples had display-enabled devices as well as private Internet networks with quick access to the information. These will influence the success of this technology in the future.

6. Acknowledgement

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