Virtual Reality Technology for Learning the Process of Organic Rice Cultivation

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Abstract

Organic rice cultivation is a process that requires skilled personnel. Therefore, those who have begun to study must learn from those who have direct experience through training. However, with the problem of organizing training requires a lot of location and operating costs; the idea is to apply Virtual Reality technology that helps to create a learning environment to solve problems. The objective of this research is the following: 1) develop virtual reality technology on learning to plant organic rice 2) study the users' satisfaction of the virtual reality technology system. In which the study population was farmers in Surin Province. A sample of 400 people was used by the convenient sampling method. The research tools included 1) virtual reality technology on learning about organic rice cultivation 2) satisfaction questionnaire. The statistics used in this research were mean and standard deviation. The tools were tested with sample group in conjunction with agricultural training and published through social media by collecting research data during August - September 2020. The result of research showed that 1) to be able to develop Virtual Reality technology in the form of a video that can be viewed in 360 degrees by distributing through social media via mobile applications and websites. The content shows the process of growing organic rice which consists of a total of 11 scenes. 2) The result of the satisfaction assessment showed that the samples were able to access the information easily and quickly, easier to understand the process of planting organic rice and apply the knowledge into practice by oneself. The overall satisfaction assessment results were standard deviation was 0.13 and the mean was 4.34 which can be implied to be at the high level.

Keywords: Virtual reality in rice planting, Organic rice, Virtual reality

Introduction

Surin province is located in the northeastern part of Thailand. The province is a source of building reputation for the agricultural sector of Thailand. Surin is a land where the best organic jasmine rice is grown in the country and world. There are more than 3 million rai of rice planting area, especially Surin organic rice, which is of acceptable quality. The province has announced a policy to be an organic, chemical-free, and toxic city since 1999, and the Council of Ministers passed a resolution on 12th November 2001 to make Surin Province as the pilot province for organic agriculture of Thailand and the province has been developing organic agriculture to international standard in order to increase the output and the quantity of foreign exports even more. On 12th August 2004 in Surin Province has announced the use of the Surin Organic Farming Standard as the first province of Thailand in 2006 (Office of Relations, 2020) At present, the province has developed organic agriculture to international standards to increase productivity and export volume by applying for certification of all 3 organic standards, namely organic standards of Organic Agriculture Standards Agency, Organic Agriculture Standards of the Department of Agriculture Ministry, Agriculture and Cooperatives and Surin Organic Standards.

Organic rice cultivation it is a process that requires both experience and expertise in planting. The agencies involved in agricultural support apply a mechanism to transfer knowledge from model farmers and academics

to farmers who are interested in organic rice cultivation through the management of training that operates in the manner of lectures to educate. The operation in such a manner requires operating expenses and time. The participants have difficulty in understanding the content due to lack of practice. There is a limit on the perception of information including the effect on target audiences which is limited in a narrow circle. Due to the fact that, in each training session, the number of farmers is small because of the traveling problem. Furthermore, the training period is inconsistent with the participants' free time that the target group can attend the training.

From the aforementioned problem, the researcher has the idea of developing Virtual Reality technology. The aim is to be a learning model that reduces the limitations in many ways, according to a study by Kovas, Grivokostopoulou, Perikos, and Hatziligeroudis (2020) that uses Virtual Reality technology to simulate entrepreneurial learning. As a result, it was found that the learners were more involved in learning and were able to understand the content more easily. Besides, there is also a research by Satapanasatien, Phuawiriyakul, and Moodleah (2021) that uses Virtual Reality technology to practice firefighting skills through simulation. The result of the study found that knowledge can be disseminated to audiences of many age groups and the system evaluation result was 90%, therefore, this research has an idea to bring such technology to simulate the situation in order to learn about organic rice production from the beginning of production to the final process which is divided into 10 steps as follows. 1. Selection of planting area 2.Selection of rice variety 3.Rice seed preparation 4.Soil preparation process 5.Rice planting method 6.Soil fertility management 7. Weed control 8. Pest control 9.Water management 10.Production storage scenes presented in the form of 360-degree video, with tips and knowledge about organic rice cultivation at the end of each scene. It is presented in the form of video media, Infographic.

Research Objectives

1) To develop virtual reality technology on learning to plant organic rice

2) To study the users' satisfaction of the virtual reality technology system about planting organic rice

Methods and Materials

1) Independent variable virtual reality technology

Dependent variable the level of satisfaction in operating the system

Research hypothesis: virtual reality technology to provide knowledge on organic rice cultivation causing the users has a high level of satisfaction.

2) Population and sample: 179,266 farmers in Surin Province used the Taro Yamane formula (Yamane, 1967) to calculate the sample size which equaled to 400 people selected by using a convenient sampling method.

3) Research instrument design: this research uses a research tool divided into 2 parts: 1) virtual reality technology system on learning about organic rice cultivation; 2) satisfaction questionnaire, The operation details are as follows.

3.1) Development of a virtual reality technology system on the learning of organic rice planting consists of a 3-part system as shown in Figure 1 using the SDLC 7-step system development concept

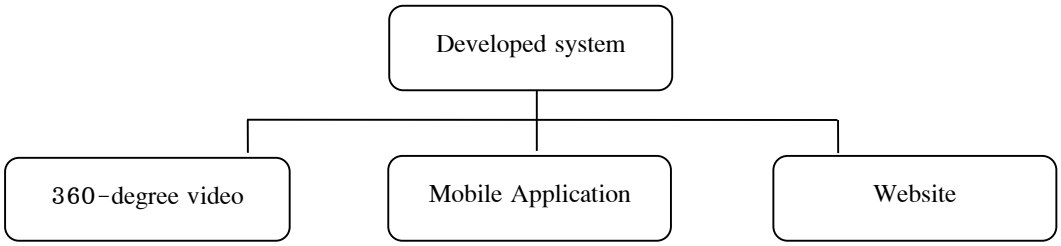


Figure 1 Developed system

Step: 1 Problem search uses method of collecting information from relevant sources by collecting data in 2 formats: 1) Primary Data is performed by using expert interviews, namely Office of Agriculture official and interviewing organic farming data from the sample farmers. The used tool is In-depth Interview with open-ended questions. 2) Secondary Data from a book study on planting organic rice, knowledge documents from experts of the Agricultural Office, Surin Province, and information from the Rice Department website (Rice Department, 2020)

Step: 2 Feasibility study in order to assess the feasibility of developing a system, studies 3 areas: 1) Tool technical aspect: Currently, the officer of the Agricultural Department of Surin Province owns computer devices and smart phones which helps them access information via the Internet from anywhere and anytime. Availability of service in the field of server could be provided by installing through the researcher's office and used efficiently; 2) Personnel and readiness: in terms of the availability of hardware equipment, the researcher provides a system which supports the continuous development of information and services including information personnel who closely supervises the system. Agricultural information, there are officers from the Surin Provincial Agricultural Office who coordinate and update information; 3) Value: due to the development of information system becomes a low-cost software that meets the demands of quality and no maintenance costs required. Therefore, the research work has an operating fee which occurs only during the development phase however, once the system is put in place, there is no cost incurred. When comparing the long-term cost-effectiveness of the project, it is appropriate to develop such a system.

Step: 3 Analysis: from the study of original work system processes from agricultural experts of the Surin Provincial Agriculture Office. This is to disseminate knowledge in the form of documents and use the training as a transfer process. From the process of working with the original system, it was found that the dissemination of knowledge documents was in an academic format. There are articles which were presented, caused the recipient to be difficult to understand and caused discrepancies including access to information, which restrictions on location and time occurs. Therefore, the problem has been analyzed and the solutions proposed as follows; 1) Adjust the format of presenting information through 360-degree video in order to stimulate the recipient's interest and understanding of the information which encouraged to be distributed by showing the process of planting organic rice as follows; 1.Selection of planting area 2.Selection of rice variety 3.Rice seed preparation 4.Soil preparation process 5.Rice planting method 6.Soil fertility management 7.Weed control 8.Pest control 9.Water management 10.Product storage. 2) The information could be presented through the application as an alternative to education of farmers groups. The information is presented in an easily understandable Infographic format which could be easily accessed from your mobile, smart phone from anywhere and at any time; 3) The website required to be easily used to manage the information, used from

any device, provided content editing and event photos managing and to provide a forum for discussion in order to exchange agricultural knowledge.

From the needs of system users, the researcher could analyze and design the workflow of system into 3 parts: 1) 360-degree video usage as shown in Figure 2; 2) mobile application shows the work analysis process as in Figure 3 and; 3) The website shows the work analysis process as in Figure 4.

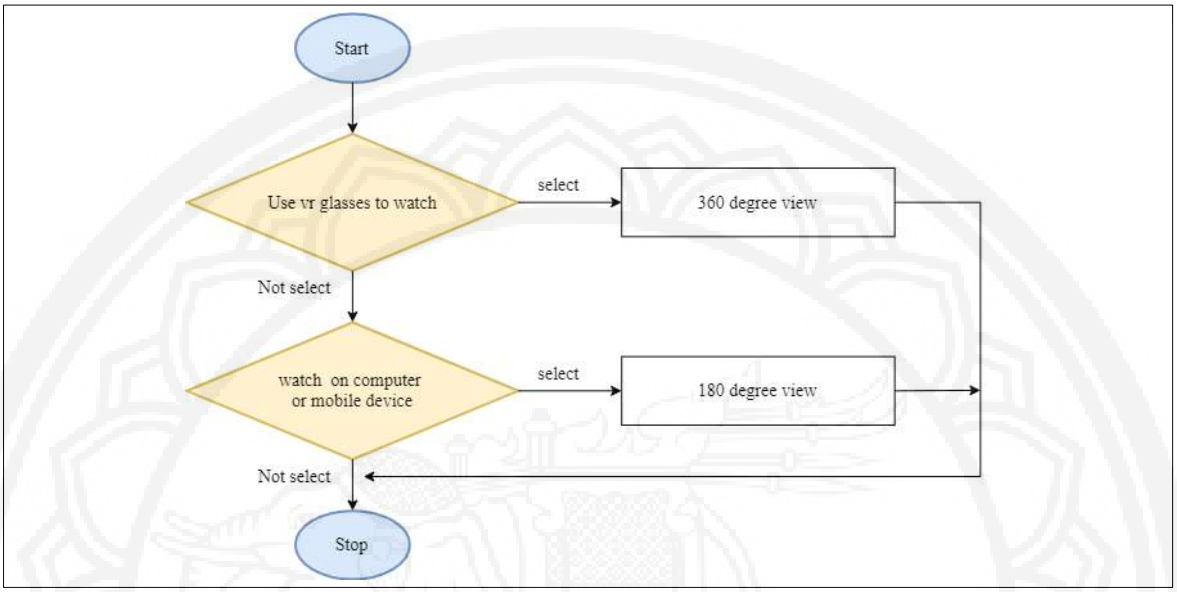


Figure 2 360-degree video usage

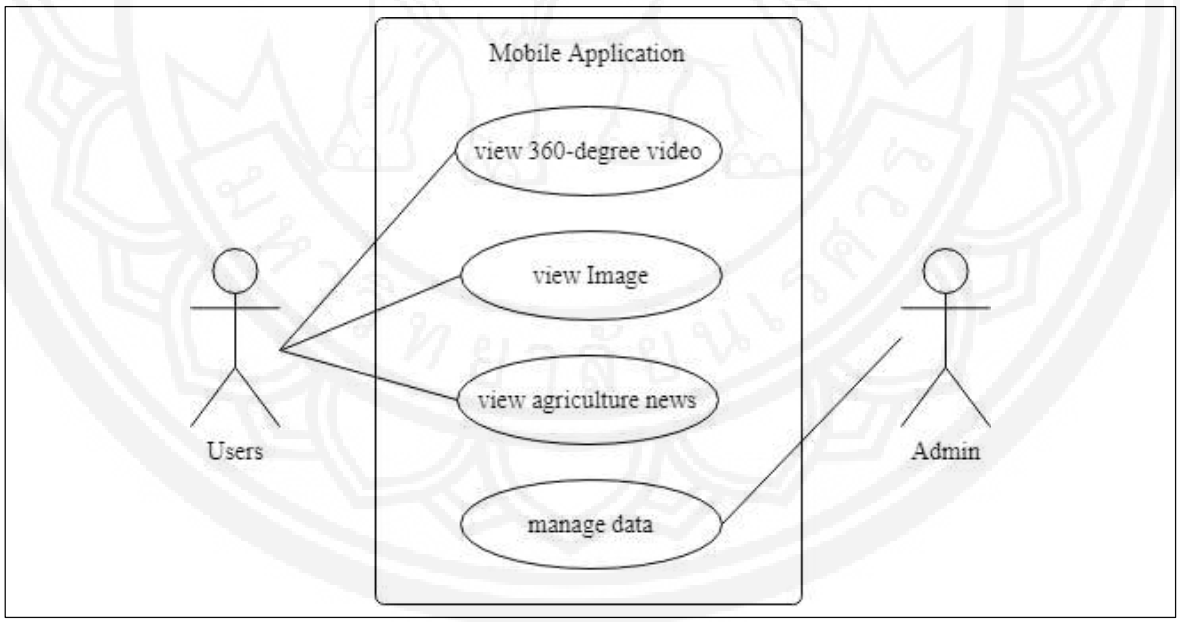


Figure 3 Use Case Diagram shows how the application works

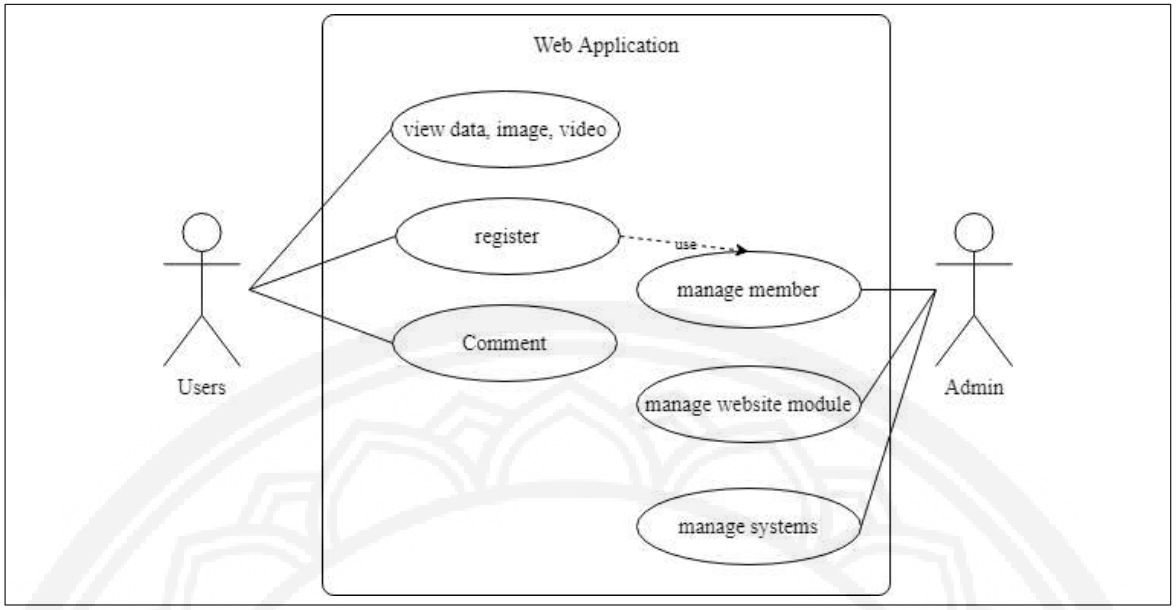


Figure 4 Use Case Diagram shows how the application works

Step: 4 The design is divided into 3 parts: 1) 360-degree video 2) Mobile application 3) Website details are as follows.

4.1 360-degree video storyboard is designed in order to sequence the content of information presentation which divided into 11 scenes total consisting of 1) Farmers' introduction 2) Selection of planting area 3) Selection of rice seed 4) Rice seed preparation 5) Soil preparation 6) Rice planting method 7) Soil fertility management 8) Control Weeds 9) Pest control 10) Water management 11) Product storage. In defining the elements of the 360-degree video presentation, as shown in Figure 5, the cartoon characters are designed to be the operators to describe the content in the form of a 2D Infographic video as shown in Figure 6 and the layout of the content components are designed to be displayed on the video Infographic.

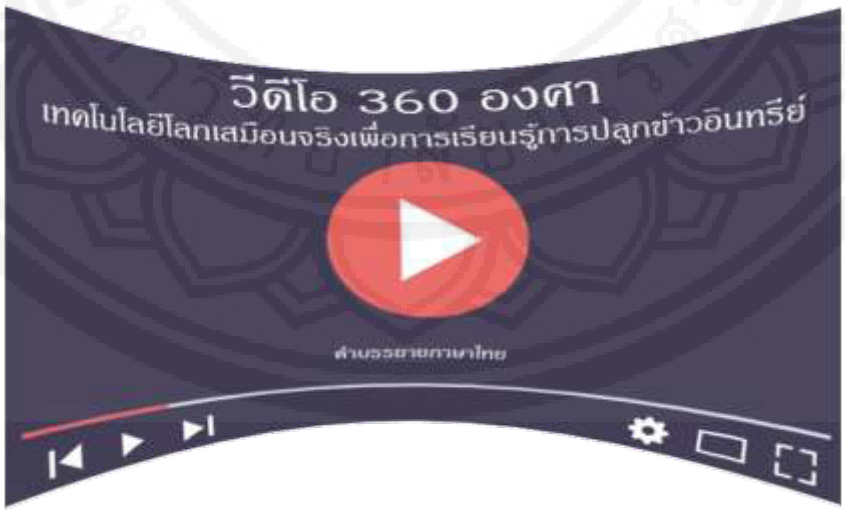


Figure 5 Display elements of 360-degree video

Figure 6 Main character design of 2D Infographic video

4.2 Mobile application is used to increase the chance to promote the public relations and to reach the target audience by getting guidelines to define a menu showing data from a preliminary user survey.

4.3 The website is a form of information publicity which is possible for messengers and recipients to quickly perceive information. It is designed for system administrator to manage content through a web browser (Backyard system) which is convenient to view and update agricultural information.

5) Development and test in this research is divided into 3 parts: 1) 360-degree video development 2) Mobile application development 3) Website development.

5.1 The development of 360-degree video is carried out by shooting a video using a 360 camera and editing afterwards to order the images in the presentation. Then, the subtitles and sound effects are added for scenes to increase visual interest. The last step is to save the file for distribution on a platform that supports 360-degree video playback.

5.2 Mobile application development is based on Ionic Framework v.4 as a development platform, with its distinctive feature which is Hybrid Application, developed in Angular language, using Visual Studio Code as a coding tool, My SQL database to manage data and the data exchange in the form of JSON files as a means of transferring data between an application and a database as shown in Figure 7.

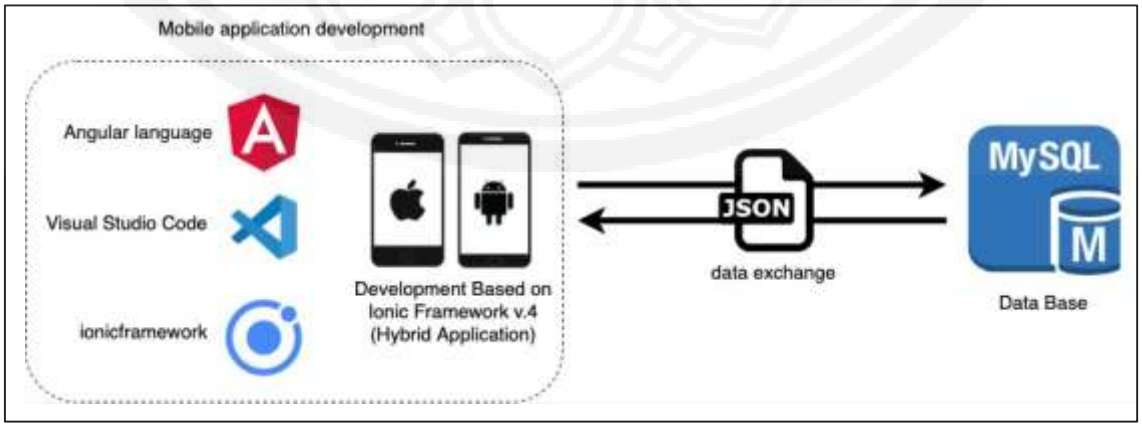


Figure 7 Mobile application architecture

5.3 Website development in this research has been developed the website in PHP Java JavaScript and CSS3, divided into 2 main parts: 1) The administrator 2) The user of system using My SQL database.

6) The installation in the system development phase is divided into 3 parts, where part 1 is installing on the website of www.YouTube.com. It is an installation through a 3rd party service provider; Part 2 is the application using APK format file preparation to be installed on an Android mobile phone and; Part 3 website development installed on the server system of organization which the researcher has operated by installing My SQL website and database system, then linked the system and opened the service.

7) System maintenance by tracking system usage for a period of 1 year. The data has been collected through user questionnaires and expressing opinions through the information receiving system. These were used to modify and develop to enable the system work in accordance with the use of period. A manual for the system and training on how to use the system for the officers of the Surin Provincial Agriculture Office were provided.

3.2 A questionnaire of satisfaction in using the system development divided into 3 parts; Part 1: The respondents' general information consisted of gender, age which are closed-ended questions; Part 2: Satisfaction with the use of system, the answer is a measure of the Likert Scale (Koch, 1983) where 1= very low; 2 = low; 3 = moderate; 4 =high; 5 = very high, which the criteria for interpreting the results are as follows: 4.50 or more means most agree; 3.50-4.49 means strongly agree; 2.50-3.49 means moderately agree; 1.50-2.49 means slightly agree; Below 1.50 means least agree and; Part 3: Recommendation, the process of creating a questionnaire consists of: 1) Planning, 2) Selection of question types, 3) Question defining, 4) Drafting of questionnaires, 5) Quality checks, 6) Publication of complete questionnaires.

4) Data collection by determining the indicators of this research which, consisted of 5 factors: 1) The format for presenting information is interesting and novel, 2) Quick and easy access to information, 3) Easier to understand the process of planting organic rice 4) Able to apply knowledge by oneself 5) Able to transfer the gained knowledge to others Data collection method by questionnaire was conducted by collecting directly with the sample and collecting data via the Internet Data collection which was carried out during July - August 2020.

5) Data analysis, the data is divided into 2 groups: qualitative data and quantitative data. The questionnaire was divided into 3 parts, comprising: 1) general information consisting of gender, age (quantitative data), 2) satisfaction level, the answer is a measure of the Likert scale (Koch, 1983) with five levels, five items (quantitative data) and; 3) suggestion (qualitative data).

Results

The results of the development of 360-degree video were that could be displayed in a 360-degree video, divided into 11 scenes as shown in Figure 8, and developed a video Infographic that could be displayed in conjunction with a 360-degree video in a total of 11 scenes as shown in Figure 9.

Figure 8 360-degree video

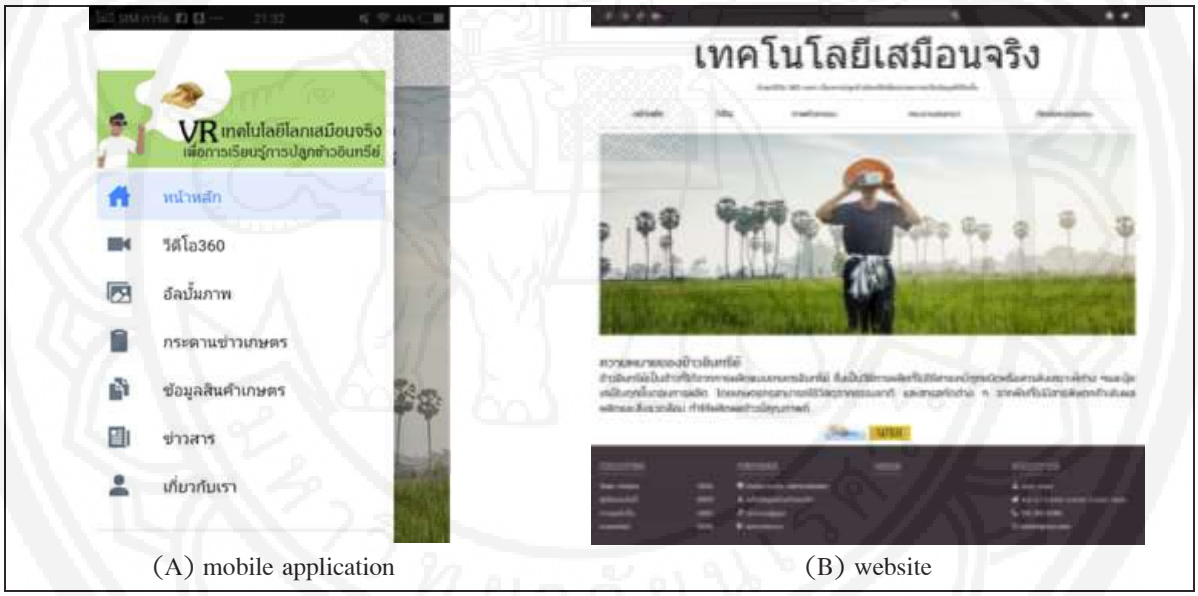
Figure 9 Infographic video

The results of 360-degree video dissemination from the development of 360-degree video has been distributed through social media channel using the platform of www.YouTube.com to allow users accessing the information more easily from anywhere, as shown in Figure 10. Then the video was published in all 4 formats, including 1) published through publicity brochures as shown in Figure 11 (A), 2) published through publicity poster as shown in figure 11 (B), 3) Distributed via mobile application as shown in Figure 12 (A) and 4) published on the website as shown in Figure 12 (B).

Figure 10 360-degree video publishing results

(A) Publicity brochure (B) Publicity poster

Figure 11 Publicity poster and brochure



(A) mobile application (B) website

Figure 12 Publicity mobile application and website

Satisfaction study results, this research studies the satisfaction level of system usage. The system was applied to a research sample of 400 people, farmers in Surin province, who studied organic rice cultivation. The data collected during July – August 2020. The research team collected data with officials from the Surin Provincial Agriculture Office by allowing farmers to closely test the system and give advice. Then the satisfaction in use was tested from the questionnaire which was divided into 3 parts consisting of Part 1: general information, Part 2: the satisfaction level of the system usage and Part 3: the recommendations which were shown in Table 1.

Table 1 Level of satisfaction of users in virtual reality technology

	Assessment list	$\bar{x}$	$S.D.$	Satisfaction level
1.	The format for presenting information is interesting and novel.	4.62	0.68	Very high
2.	Quick and easy access to information	4.54	0.76	Very high
3.	Easier to understand the process of planting organic rice	4.18	0.91	high
4.	Able to apply knowledge into practice by oneself	4.15	1.00	high
5.	Able to transfer the gained knowledge to others	4.20	0.93	high
	Average	**4.34**	**0.13**	**high**

Conclusion and discussion

This research has two objectives: 1) to develop virtual reality technology on learning to plant organic rice and 2) To study the users' satisfaction of the virtual reality technology system about planting organic rice. This study was conducted from a sample group of 400 people who are farmers in Surin Province. This research uses research tools including 1) virtual reality technology on learning about organic rice cultivation and 2) user satisfaction questionnaire. The data was collected through farmer training with agricultural officials and collected the information through social media. The data was collected from August - September 2020 and analyzed the statistical values which consisted of mean and standard deviation.

From the research results according to the objective 1) the researcher could develop virtual reality technology to present the process of planting organic rice with a total of 11 scenes in which the learners could be able to watch and feel as though they are in the real situation. This could create astonishing viewing of information and a better viewing experience for the audience to be able to remember the knowledge. This is consistent with the research of Chantakhun (2018). The research was conducted by creating an immersive and virtual learning environment with digital storytelling to promote deep learning among undergraduates. According to the results of the study, it was found that students had an increased learning effect after learning with the said lesson. This study is also in line with Pornpimol Udomkasemsap's (Udomkasemsap, 2017) research, The development of virtual reality for tourism: A Case Study of Hua Hin Tourism Promotion. The results showed that the sample group was satisfied with the virtual environment simulating the 360-video-style tourist attractions in Hua Hin and were satisfied with the simulated guide who described the tour. It is also consistent with Pongsuwan and Taveephols' research (Pongsuwan, & Taveephol, 2017) which proposed the application of virtual reality technology for the Thai elderly in Ladprao area, Bangkok. From the research results, it was found that the technology of virtual reality was able to create new media consumption experiences that are beneficial to the elderly.

From the research results according to the purpose of 2) To study the users' satisfaction of the virtual reality technology system about planting organic rice was examined through the use of questionnaires as a research tool. In part 2 of the questionnaire, questions were divided into 5 areas to assess the level of satisfaction, which could discuss the results of each research as follows.

Aspect 1: The format for presenting information is interesting and novel resulted in the satisfaction assessment at the highest level because of the virtual reality technology has created visual attraction and a new kind of cognitive experience for the audience as if the audience actually entered into that place. This is

consistent with research by Park and Kim (2019). 360-degree video presentation of Hanbok dance was interestingly conducted.

Aspect 2: Quick and easy access to information resulted in the satisfaction assessment at the highest level. This research has developed a way for accessing information with the principles of information system development, multiple data access channels, including websites, applications, and QR code scanning. This could enable users to quickly link and access information. The study consistent with the research of Saengwar (2018) which studied the development of a communication information system to promote the performance of public health volunteers (OPS) in Bangkok. The results of the study showed that the system could provide information and advice on the health of the public quickly and easily.

Aspect 3: Easier to understand the process of planting organic rice resulted in the satisfaction assessment at a high level. Using virtual reality technology in presenting the information to increase learning efficiency resulted that the audience earned a better concentrating on the studied subject and created their awareness. This is in line with Chantakhun's research (2018), which developed the virtual reality technology for digital storytelling to promote the deep learning of undergraduate students. The results of the study showed that students had an increase in average grades after studying. It is also in line with the research of Choi (2019) developing virtual reality technology for teaching nursing students on safe bandage closure. The study showed that the samples were able to learn the content better.

Aspect 4: Able to apply knowledge into practice by oneself resulted in the satisfaction assessment at a high level. The virtual reality technology has simulated a situation as if the audience were in the real event. Therefore, learning from a model is a great way to build a better understanding and learning guidelines which leaded to the correct implementation of such knowledge. This in line with research by Rajeswaran, Varghese, Kumar, Vozenilek, and Kesavadas (2019), this study developed a virtual simulation trainer for intubation training. For medical students to be able to learn and follow them properly. It showed that the learners had a correct understanding of the practice process and also helped the physicians prepare their minds before starting the actual treatment.

Aspect 5: Able to transfer the gained knowledge to others resulted in the satisfaction assessment at a high level. By learning with the virtual reality technology, learners gain the knowledge and understanding of studied content. As well as this could lead to the transfer of gained knowledge to others to learn about such process. This is in line with research by Yépez, Guevara, and Guerrero (2020) which conducted by creating applications to simulate classrooms for students with distance learning. The student could learn as if sitting with their teacher. The results of the study showed that students were able to learn the content and were satisfied with their learning with this method.

Research recommendations from the results of this research, the research results were mutually applied with the Surin Provincial Agriculture Office to be an equipment in terms of support training in organic rice cultivation The developed Virtual Reality technology can help to create a learning model that encourages learners to understand the content. It can reduce restrictions on location, time, and expenses. Therefore, it is a guideline for researchers who are interested in developing a learning model of simulation, creating an environment where students can participate in the practice and explaining complex events for learners to visualize and understand more easily and to create experiences for the target audiences without having to travel to the actual location.

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