Augmented Reality Applied in Subak Museum: Preserving Local Wisdom Subak Concept

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Abstract. Augmented reality is becoming a trend and an important element in today's digital world, not only in the world of education but also already interacting with business and organizational services. Museums as public service organizations need to change the look to be attractive and in demand by visitors and be up to date. Subak Museum is a public organization that stores a large collection of agricultural tools that have high knowledge value and need to be preserved. The purpose of this research is to develop Augmented reality in subak museums. 4D development models (define, design, development, disseminate) are used in the development and have been through expert appraisal. In the trial of 25 respondents obtained results that are practical aspects with a result of 67% practical, 23% very practical, and 10% impractical. While in the aspect of effectiveness obtained results 86% very effective and 14% ineffective. The results showed that augmented reality museum subak has received a positive response from respondents but needs a more in-depth assessment related to user experience design (UXD).

Keywords: Augmented Reality Technology; Subak Museum; Subak concept.

1 Introduction

Technology has become an important element in today's digital life. The way users interact with different business services is changing due to Augmented Reality (AR), and the use of this technology on handheld devices is becoming increasingly important. Public and private organizations should not be missed, and they should strive to meet the demands of interactive services with AR [1]. AR is a technology that enables the superposition of virtual 3D objects in a real 3D environment. This is achieved due to a device equipped with a camera and screen that allows users to enjoy the immersive experience offered by AR. The technology aims to enrich the real environment with virtual information, creating opportunities to offer collaborative and real-time input of the physical environment without the need to populate the physical environment with objects that can hinder interaction. AR has been successfully applied in areas, such as industrial design, education, health, and psychology [2].

Augmented Reality works based on image detection in the form of markers. Starting until the Augmented Reality app finds a match with the marker identification results, either through marker-based or markerless tracking. The application recognizes a specific marker, then the Augmented Reality application displays overlay information on top of the identified marker image. Augmented Reality applications can then display a wide variety of types of information,

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such as playing audio or video clips related to markers, displaying text information, historical facts related to location, and 3D models. The ability to bring up 3D objects accompanied by information on gadgets makes Augmented Reality is not tedious to use.

Nowadays, many museums in Indonesia use Augmented Reality in packaging the look of the museum to be interesting, the strong Hi-tech impression makes visitors' interest increase and can preserve the cultural value of the museum, such as the zoological museum located in Bogor, West Java, Gedung sate with its Hi-Tech tourist museum in Bandung, R.A Kartini Museum in Rembang, Fatahillah Museum and Wayang in Jakarta Old Town, and many other museums [3][4][5]. Regarding museums in Bali that have implemented AR, such as the Neka Museum in Ubud and the Bali Museum in Renon Denpasar.

Subak Museum is one of Bali's icons that stores agricultural tools of Balinese cultural heritage through the concept of Subak network has been recognized by the World Health Organization (WHO) as a World Cultural heritage. The implementation of Subak Concept can be seen in the Jatiluwih Tabanan area, which has become the main tourist destination in Bali. Interestingly, Subak's concept of equitable water management is based on the norms that have been used by ancestors for centuries in managing Bali's agriculture.

The scientific value in the concept of subak is very interesting to discuss and has been widely studied by researchers both from inside and outside. Such studies, for example, by scholars in the field of law concerning awig-awig, are used to ensure an equitable sharing of water resources [6][7][8][9], in the social, agricultural, and tourism fields have also been studied among them [10][11][12], while in the field of special education in learning content, such as Subak concept that has similar concepts with computer networks [12][13], oriented at the area of technology, there are still few researchers who investigate and are highly under-explored. The Government of Bali, especially Tabanan, has been working to preserve the cultural heritage and concept of knowledge inherited by the ancestors through the existence of Subak museum.

However, the public does not understand the significance of the Subak Museum as a cultural legacy from a past generation that has been preserved to the present day. The younger generation who are expected to be the successors of the nation who can maintain traditions, especially in the field of agriculture, are reluctant to visit the Subak Museum even if it is just to look around the existing collections. Whereas they are expected for the sustainability of life in the field of agriculture. Referring to the problem, how to make changes in terms of performance at Museum Subak to add to the attractiveness that packaging follows the current trends and is favored by the younger generation.

Researchers provide solutions by implementing the Augmented Reality Subak network system concept as an integrated electronic system or infrastructure that provides information on how Subak network system concept works and process and agricultural tools that support, making visitors especially young generation (students) get a new and interesting experience for them. The update of this research is, the absence of Subak studies that lead to the field of technology, how the irrigation network system works with agricultural tools that are functioned in such a way, and the concept of equitable distribution of water resources will be packaged in Augmented Reality (AR).

AR in Subak museum does not replace the existence of Subak museum but modifies the visualization of content in the museum to be more interesting and valuable. The information presented visually adds a dynamic impression to about 250 collections of agricultural tools that are original objects that are prone to break or damage and difficult to find replacements for the collection of agricultural tools. ART functions as Electronic Performance Support System (EPSS) that aims to help visitors when they need help in understanding how Subak network systems are designed to distribute water resources equally. The visual elements that can be

added can be a video or virtual modeling of 3D objects [14][15]. The Subak network system turns out to have similarities to the concept of computer network, so it can be analogous to strengthen the level of understanding of the concept of learning [16].

The state-of-the-art of this study is the augmented reality network system Subak, which will provide a new experience for visitors in constructing their knowledge. This experience will allow them to form a mental scheme model in their minds and will evolve into a wider and more sophisticated process through two complementary processes namely assimilation and accommodation. The experience here is the experience of visitors through the culture of local wisdom that they have known and have as an ancestral heritage in their social environment. The local wisdom is that the Subak network system that has the concept of resource management is almost similar to the concept of a computer network. The question to find a solution in this article is How to develop an Augmented Reality in a museum that is practical and effective as an effort to preserve the local wisdom of the Subak concept?.

2 Research Methods

Methods used is Research and Development using 4D (four-D) stages consisting of Define, Design, Development and Disseminate with the following stages, (i) Define is conducting a needs analysis related to the current conditions conducted by interviewing, observation and giving questionnaires to the museum manager and visitors of Subak museum, as well as analyzing the content needed to support the AR system, (ii) Design and (iii) Development i.e. designing and developing AR systems that match the content of previous analysis results as well as analysis of Subak network systems that can be visualized in augmented reality [17]. In the Development stage is also done expert appraisal and developmental testing; stage (iv) Disseminate into three activities namely validation testing, packaging, diffusion, and adoption.

2.1 Participants

In the expert, appraisal section was done one-to-one expert judgment by two experts related to the justification of conformity (validity) of content implemented in AR and artifacts that are designed with its form and function. The results of the input by both experts are included in the matrix table of the Gregory formula to find out the rater and the minimum acceptable value. Furthermore, two design and media experts are also required to justify the graphic and functionality of the Application. Visitor participation in this application simulation is indispensable to provide constructive input to the AR.

2.2 Data Collection

The data obtained are grouped according to nature into two parts, namely qualitative data and quantitative data. Data classified in qualitative data is in the form of inputs, comments, and written suggestions either from expert judgment or validators involved using the Guttman scale, while quantitative data can be obtained from visitor responses related to the practicality and effectiveness of the response questionnaire using a Likert scale.

2.3 Data analysis

The collected data is descriptively analyzed. Data from expert test results are analyzed with Gregory's formula. For data on validity, practicality, and effectiveness, the analysis is based on

qualitative and quantitative data analysis. The conversion guidelines used are presented in Table 1 below.

Table 1. Conversion Guidelines

Interval	Validity Criteria	Practicality Criteria	Effectiveness Criteria
$3,5 \leq X < 4,0$	Very valid	Very practical	Very effective
$2,5 \leq X < 3,5$	Valid	Practical	Effective
$1,5 \leq X < 2,5$	Invalid	Impractical	Ineffective
$1,0 \leq X < 1,5$	Very invalid	Very Impractical	Very Ineffective

3 Finding

The system overview of Subak's Augmented Reality Museum App is the overall flow of the app's work process. The interaction process between the software and the user can provide a clear form of process that occurs in the application such as input and output of the process being worked on. The overview of the designed application is expected to allow the user of the application to easily understand and use the application.

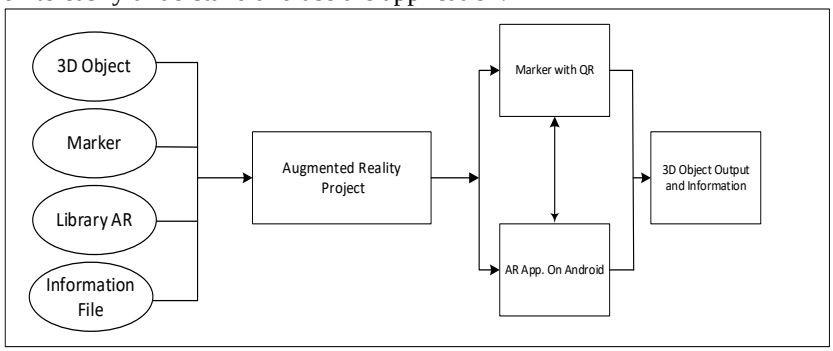

Fig. 1. Overview of the AR Museum Subak app

Figure 1 describes the flow of the application created to be created. The first step is to create a 3D object from objects in the Subak museum, prepare an information file for each object that is made into 3D, search and create images so that it becomes a library marker. Early-stage data was combined into a key component of Subak Museum's Augmented Reality application project. Augmented reality projects produce applications capable of being used on the Android platform that can be used directly to detect markers, resulting in 3D object output and information from those objects.

The Subak Museum collects about 250 collections of agricultural tools used by ancient ancestors in the process of maintaining Balinese cultural traditions. In the collection was chosen a scenario/process flow how water resources present irrigate the rice fields in the surrounding area. In this process are created some characters that support the scenario as in Figure 2.

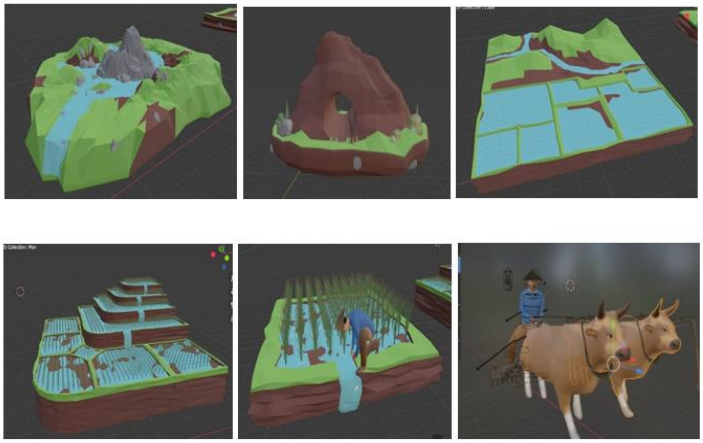

Fig. 2. Characters created in a single scene

The main menu scene is the appearance of this application, in the Main Menu Scene is the determination to choose the three menus provided i.e. (i) the story of Subak (ii) tour with AR, and (iii) analogy of the concept of Subak. In the menu section of Subak's story, visitors will be directed to the history and philosophy of Subak for Balinese people. Then on the tour menu with AR, showed a collection of agricultural tools according to the flow scene how the water source flows through the surrounding rice fields with functional agricultural tools used. In the menu Analogy concept Subak, given a description and simulation that the concept of Subak analogy with the concept of computer network that is on the concept of network topology and distributed systems. The concept of the Subak network manages fair water resources while the computer network manages bandwidth resources from the server to the client.

The application trial was conducted on 25 respondents on the practicality and effectiveness aspects of the Subak augmented reality museum application. Respondents were taken from various circles who are interested in the museum Subak as shown in Figure 3 below.

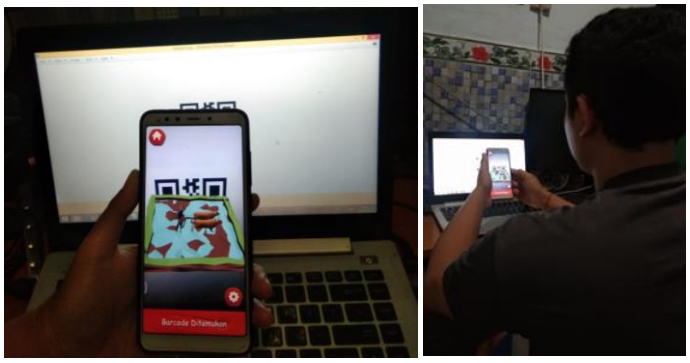

Fig. 3. Trial of Augmented Reality Subak

The results of the application trial data are then analyzed using qualitative descriptive analysis. The results of the analysis are then compared to the conversion table to know the data qualitatively. The conversion results are shown in Figure 4 below.

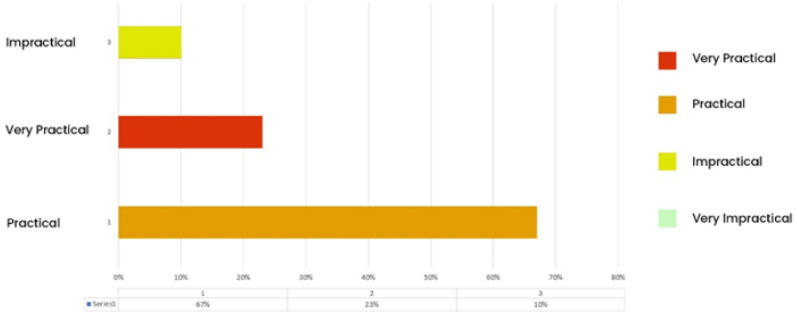

Fig. 4. Augmented Reality Subak Practicality Test Results

Figure 4 shows that the practical aspects of the overall application process can be said to run well and as expected. This is following the results of the survey that shows the highest average rating on good value (practical) of 67%. The excellent average value (very practical) has a value of 23% which indicates the application is easily understood by the user. A poor (impractical) value of 10% indicates that there are still technical problems with the use of the application such as too long for the application to process some commands. The length of time required is because the Subak Augmented Reality Museum application has a large enough size, which is ± 115 MB. After all, it uses complex assets.

In the trial of the effectiveness of augmented reality products, Subak used quantitative descriptive data analysis by disseminating questionnaires to respondents. The main aspect analyzed is the effectiveness of camera-to-marker time detection to 3D objects in augmented reality applications. The results of the effectiveness trial analysis are presented in Figure 5 below.

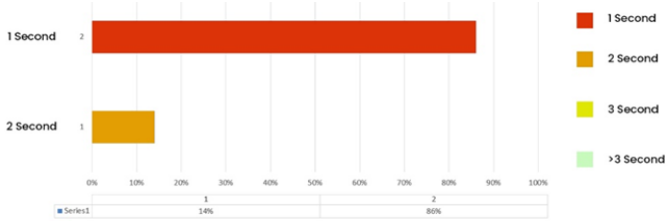

Fig. 5. Results of Subak Augmented Reality effectiveness analysis

The effectiveness aspect shown in Figure 5 shows that through the detection of camera time to marker until it brings up 3D objects in the Subak history menu, the tour with AR and Subak concept analogy has been running as expected with the largest average value being one second with a percentage of 86%. This value indicates that Subak's Augmented Reality Museum app is already running well and as expected. The average value of 14% at two seconds point is due to the incorrect position of the marker book or smartphone used in detection.

4 Conclusion

Subak's augmented reality museum has gone through the required stages and received a positive response from experts and respondents. In terms of practicality obtained results 67% practical and 23% very practical but 10% impractical. While from the aspect of effectiveness

obtained results 86% very effective and 14% ineffective. There is still a need for a more in-depth assessment related to user experience design and Subak concept content that has high knowledge value and needs to be preserved.

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