Design and Development Augmented Reality Application to Introduce the Potential of Sudaji Village in Bali Using the Design Thinking Method

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Abstract

Indonesia is a country that has diversity, both in terms of ethnicity, customs, religion, and language. One of them is the island of Bali, the island of Bali is one of the parameters of Indonesian tourism. Data on the high number of tourist visits to Bali before the pandemic increased. This is what affects the economy in Bali. However, due to the COVID-19 pandemic, tourists visiting Bali have decreased. In an effort to increase the economy due to the pandemic in the tourism sector, the Province of Bali continues to develop villages in Bali into tourist villages. One of them is Sudaji Village, Sudaji Village is included in the top 50 Indonesian tourist villages, the current digitization in the form of websites, YouTube, Instagram, Tiktok, Facebook which is used to provide information about the potential that exists in the village. However, the digitization is still not enough to encourage tourists to know about Sudaji Village, especially domestic tourists. This is evidenced by the results of interviews with five domestic tourists, stating that they have never heard of tourism in Sudaji Village, Bali. In the development of digital villages in Sudaji Village, namely using Augmented Reality (AR). Augmented Reality (AR) is a technology that has a lot of potential to be developed in various fields. This study uses the design thinking method with 5 stages, namely empathize to find out about the problems of potential users, define to define problems from the data that has been obtained, ideate, which is to create solutions or ideas based on existing problems, prototypes make products from the results of the previous stages, and the fifth stage, namely testing carried out by 5 potential users to get an SUS score of 82 which is included in the A value with excellent information.

***Keywords*:**Sudaji Village; Augmented Reality; Design Thinking.

I. Introduction

Indonesia is a country that has diversity, both in terms of ethnicity, customs, religion, and language. Therefore, Indonesia is a country that is rich in the potential for cultural diversity and natural resources. These natural resources can be used as a source of potential to encourage the economy and prosper the people in Indonesia. One of them is the island of Bali, the island of Bali has the potential of abundant natural resources. This makes Bali one of the parameters of Indonesian tourism and a benchmark for the development of other tourism destinations. The tourism sector is the

sector with the most potential on the island of Bali other. The high number of tourist visits to Bali in July 2019 reached 604,480 tourists [1]. This is what affects the economy in Bali, starting from foreign exchange earnings, improving the community's economy, wide open job vacancies, preserving culture and local wisdom, as well as the impact of infrastructure development that is continuously updated. However, due to the COVID-19 pandemic, from January to July 2021 only 43 foreign tourists visited Bali [2].

To seek economic improvement due to the pandemic in the tourism sector, the Province of Bali continues to develop villages in Bali into tourist villages, the development of this tourist village is developed while maintaining and preserving culture in Bali, not the other way around. A tourist village is a community in an area with the ability to empower tourism potential in the region [3]. There were only 122 tourist villages in Bali in 2014. Tourist villages in Bali in 2018 continued to be developed, and reached 162 villages, one of which is Sudaji Village [4].

Sudaji Village in 2022 became a village that was included in the top 50 awards for the Indonesian Tourism Village [5]. Sudaji Village is a village located in Buleleng Regency, Sawan District, Bali Province. Sudaji village has an area of 817 ha, covering 453 ha of rice fields, 210.68 ha of plantation land, 94.5 ha of yard land, and 40 ha of state land. Sudaji Village has its own natural and cultural potential that is continuously preserved. Some of the tourism potentials in Sudaji Village are Gandameru, Ngusaba Bukakak Festival, Forest Bathing Sudaji Village, Melasti Ceremony in Sudaji Village, as well as fruit seed producers [6].

The tourism village that was developed did not escape the combination of local wisdom with the impact of today's technological developments. Sudaji Village is included in the top 50 Indonesian tourist villages, the current digitization in the form of websites, YouTube, Instagram, Tiktok, Facebook which is used to provide information about the potential that exists in the village. However, the digitization is still not enough to encourage tourists, especially domestic tourists, to know about the potential that exists in Sudaji Village. This is evidenced by the results of interviews with five domestic tourists, stating that they do not know and have never heard of tourism in Sudaji Village, Bali. They only know about tourism in Denpasar, Bali. In 2021, 89% of the population in Indonesia, already use a smartphone [7].This is what can support the development of digitalization in Sudaji Village. In the development of digital villages, one of the technologies that is often used is Augmented Reality. Augmented Reality (AR) is a technology that has a lot of potential to be developed in various fields, for example in the entertainment, design, and tourism sectors [8]. The application of Augmented Reality in Dago by applying a mural as a marker that will display stories about Sundanese culture when the smartphone is pointed at the mural, this is what makes visitors interested in visiting the place [9]. In addition, research on 3D maps by applying Augmented Reality markers is effective in presenting regional boundaries, locations of hamlet heads, schools, places of worship, places of economy, tourism, culture, geographical conditions and potential [10].

Based on the problems above, the researcher uses the design thinking method in the development of Augmented Reality applications in Sudaji Village. This is because the design thinking method can analyze the needs of potential users well at each phase. This application will be compiled by making objects in the form of videos, visualizing 3D objects, and markers in the form of souvenirs, equipped with a location finding feature, a feature for purchasing tickets to Sudaji Village, and a marketplace feature for purchasing souvenirs that have a special feature, namely there is a marker to detect objects. videos and 3D objects about Sudaji Village.

II. Method

The research and development method used in developing the Augmented Reality Application in Sudaji Village is Design Thinking. Design Thinking is an iterative process to understand user needs. In the design thinking method, it is divided into 5 stages
namely empathize, define, ideate, prototype, testing [11]. The stages of the design thinking method are shown on Figure 1.

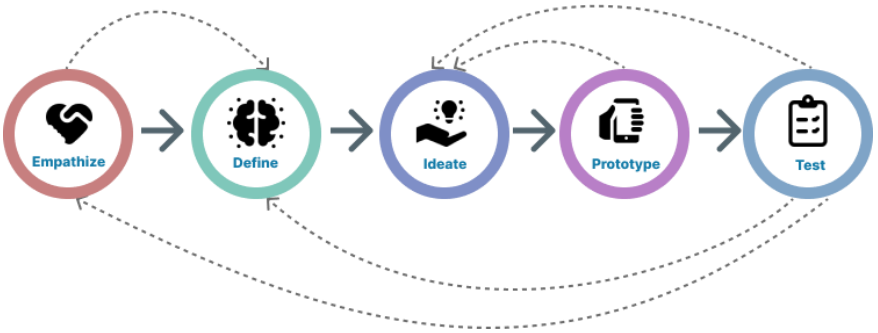

Figure 1. Stages Design Thinking

1. *Empathy*

In the first stage, what is done is to find out the problems and needs of potential users. Researchers conducted interviews with 5 sources. Interviews with 5 respondents were able to find about 85% of usability problems and usually the fourth and fifth interviews only confirmed the first three interviews [12]. Data collection is done by interviewing the informants directly regarding the problems, needs, and research plans, and application development. To form questions on points 1-14 the researcher used references from [13] and [14], which were then developed according to the needs of this study. The following are the criteria for prospective users of the Sudaji Village augmented reality application:

1) The general public who often visit tourist attractions at least 2 times, in 1 month
2) The general public who use smartphones.

The following is a list of questions that will be asked by the researcher to the informants:

1) Have you ever been on a sightseeing trip?
2) How often do you travel in a month?
3) What tourism categories do you often visit?
4) Do you have a smartphone?
5) Do you often use your smartphone when you travel?
6) When you travel, what do you use your smartphone for?
7) Have you ever used a special application to find information about these tourist attractions?
8) Do you know or have ever heard of a tourist village in Sudaji Village, Bali?
9) In reaching the destination tourist information, what kind of information services have you used, which is described in question number 6?
10) Where do you usually get information about the tour you are going to, which is described in questions 6 and 8?
11) What are the obstacles that you experience, when finding out information about the tourist you want to visit, which is described in question number 8?
12) If there is an application that provides tourist information about Sudaji Village, would you be interested in using it?
13) In your opinion, what features are needed in the Sudaji Village tourism application?
14) If the application to be developed uses a combination of augmented reality technology and souvenirs, do you agree?
15) Mention the souvenirs that you like, when you visit tourist attractions, which are described in question number 13?

2. *Define*

*Define*is the stage for researchers to collect data and information obtained in the first stage, namely empathize. Then an analysis of the problems of potential users in developing augmented reality applications in Sudaji Village is carried out. At this stage the researcher will make a list of user needs in the form of ideas that come from the results of the analysis. Some of the outputs produced at this stage are in the form of an empathy map and a list of problem validation.

3. *idea*

At this stage, information from the previous stage will be used to generate ideas. At this stage, brainstorming is carried out to produce solutions to the problems that are being handled by users. Then in this ideation stage, researchers used several methods to assist researchers in collecting and making ideas as problem solutions. The method used is in the form of affinity diagrams and information architecture.

4. *Prototype*

This stage is the stage for designing the user interface with prototyping techniques. At the prototype stage it has two types of user interfaces, namely, low fidelity and high fidelity. At the low fidelity stage, it is a framework for describing and designing the layout of the application to be made. Furthermore, in designing the user interface using high fidelity, researchers used figma tools.

5. *Testing*

Testing is the last stage of the design thinking method which is carried out to test the development of augmented reality applications in Sudaji Village. In this last stage, the methods used are Blackbox Testing, Expert Validation, and System Usability Scale (SUS).

III. Results and Discussion

1. *Empathy*

The results of the interviews conducted received various answers, but some of the answers also shared many similarities regarding the habits, goals, and problems experienced by the interviewees. For the habit of respondents most often looking for information about tourist attractions to be visited through the google site, as well as websites from tourist attractions to be visited. There are also problems experienced, namely the search for information that does not match the expectations of the respondents, this makes a lot of time wasted.

2. *Define*

After getting data on user needs and problems in the empathy process, at this define stage determine the problems experienced by the user. The define stage is the stage carried out to define the problem based on existing data and determine the actual problem [15]. At this stage, to process data and define problems using an empathy map and problem validation. Here on Figure 2 is the result of empathize mapping, andTable 1is a definition to validate the problem. Based on the empathy map onFigure 2, can be obtained related to data that describes what the user says, thinks, does, and feels about tourism.

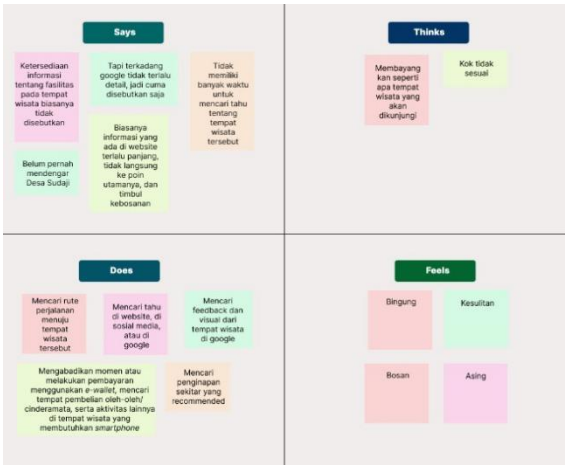

Figure 2. Empathy Folder

It can be obtained the problem mapping onTable 1obtained from the empathy map data as follows:

Table 1. Data User Problem Validation

No	Problem Statement
1.	Lack of detailed information about tourist attractions to be visited
2.	Usually the information on the website is too long, doesn't go straight to the main point, and boredom arises
3.	Requires navigation to destination
4.	Looking for feedback and visuals from tourist attractions on google
5.	Tourist attractions do not match as imagined
6.	Looking for recommended lodging around
7.	Looking for a place to buy souvenirs/souvenirs

3. idea

After defining the problem at the define stage, the next is the ideate stage. Ideate is the stage for creating concepts and outputs. The purpose of this ideate is to explore various solutions. The next stage is the researcher conducts brainstorming to determine the solution that will be developed further. Generate affinity diagrams and information architecture which will be used as a reference for making features at the application prototype stage later. Here onFigure 3is the result of an affinity diagram in the form of a solution andFigure 4 is an information architecture:

Figure 3. Affinity Diagram

OnFigure 3is a form of grouping of ideas that have been formed in brainstorming. In the affinity diagram, these ideas will go through re-screening which will be selected according to the urgency and needs of potential users.

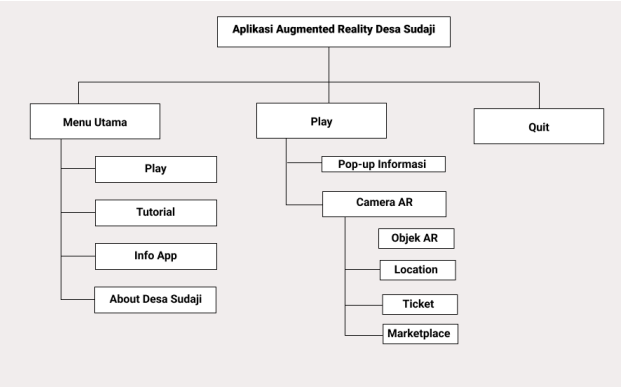

Figure 4. Information Architecture

OnFigure 4, based on the grouping of ideas obtained in the previous stage, the researchers designed the information architecture of the augmented reality application in Sudaji Village. This Information Architecture is in the form of a chart or scheme where each chart will represent the elements that exist on each page of the Sudaji Village augmented reality application.

4. Prototype

Next is designing the application layout in the form of a wireframe which is a low fidelity version of the application design to facilitate the development process. The following is a wireframe which is an overview of the layout of the Sudaji Village augmented reality application that will be applied:

Figure 5. Wireframes Main course

Figure 6. Wireframes PlayAR

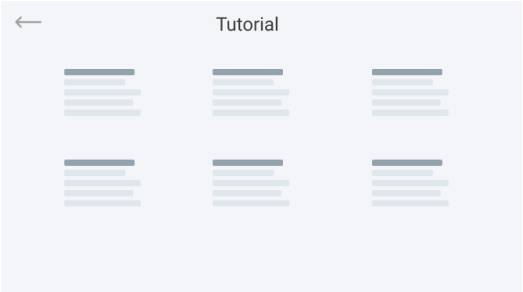

Figure 7. Wireframes Tutorials

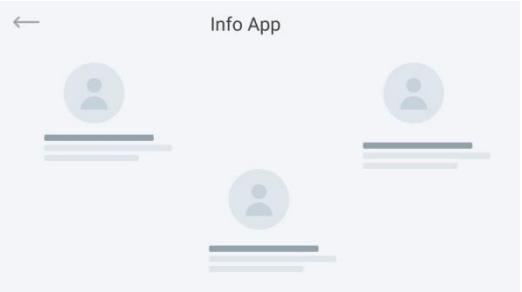

Figure 8. Wireframes InfoApp

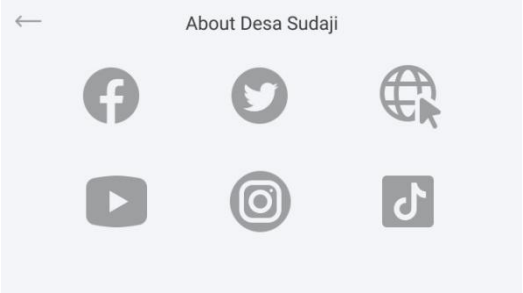

Figure 9. Wireframes About Sudaji Desa Village

The mockup is made using the figma application. Below are some of the prototype results end along with a functional description of the features.

Figure 10. Menu Display Main

Figure 10shows the display of the main menu. Where is the play and pause button

for audio. In addition, there is a description of the application title and existing menus.

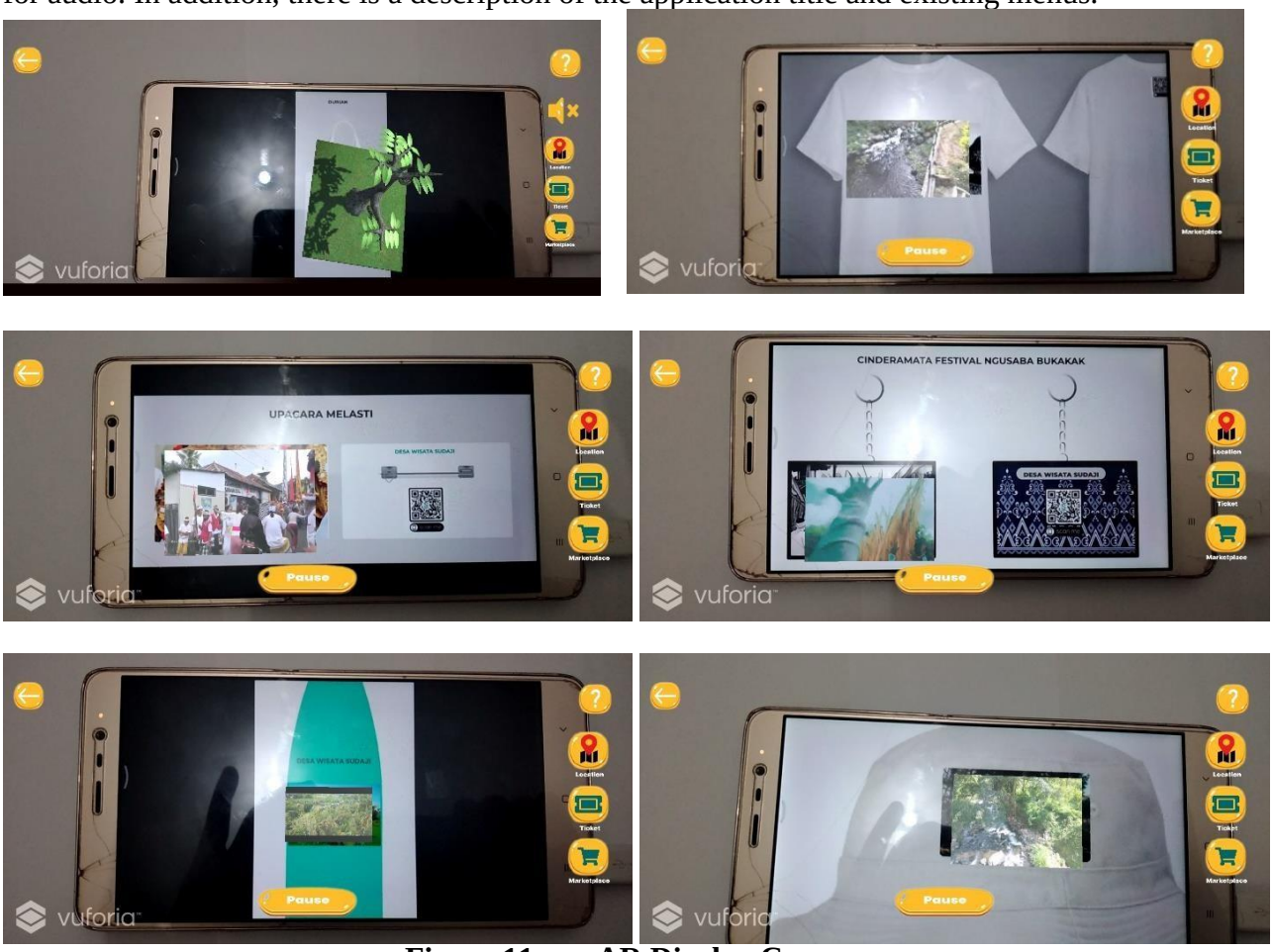

Figure 11. AR Display Camera

Figure 11 shows the view of the AR camera which consists of several objects. Where in this application there are 6 objects, consisting of 5 videos and 1 3D object. each object has a location feature, ticketing feature, and marketplace feature.

Figure 12. Showand Application Menu

Figure 12 shows the appearance of several menus on the Sudaji Village augmented reality application, which contains tutorials, application info, and about Sudaji Village which contains Sudaji Village social media.

5. Testing

In the testing phase, the augmented reality application in Sudaji Village was tested using black box testing, expert validation, and System Usability Scale (SUS). The results of this analysis by testing 42 scenarios on the functionality of the augmented reality application in Sudaji Village. The results of this black box testing work/success. Meanwhile, the media expert validation and material expert validation each get an average value percentage of 89.2% and 91% which can be shown in Fig.Table 3andTable 4,which is obtained from the calculation of the formula in equation (1) and is determined by the criterion of the level of validity inTable 2. So from the results of expert validation, the prototype can be declared valid for use.

$$\text{Persentase} = \frac{Jumlah\ Skor}{Skor\ Maksimal}\ 100\% \quad (1)$$

As for after the percentage of validity is obtained, then it is classified according to the criteria for the level of validity inTable 2 [16].

Table 2.
Criteria Validity Level

No	**Percentage (%)**	**Validation Criteria**
1.	76 - 100	Valid
2.	56 - 75	Quite Valid
3.	40 - 55	Less Valid
4.	0 - 39	Invalid

Table 3.
Results Material Expert Validation

Validator	**Rated aspect**						
	Content Eligibility	Serving Eligibility	Language Assessment	Phenomenon	Total	Category	%
Dr. Satti Wagistina, SP, M.Si	14	3	4	4	25	Very Worthy	89.2%
Average	14	3	4	4			
Category	Very Worthy	Worthy	Very Worthy	Very Worthy			
%	87.5%	75%	100%	100%			

Table 4.
Results Media Expert Validation

Validator	**Aspect Rated**						
	IntroductionApplication	User Control	App View and Augmented View *Reality*	Application Help	Total	Category	%
Rizdania, M.Kom	14	6	59	12	91	Very Worthy	91%
Average	14	6	59	12			
Category	Very Worthy	Worthy	Very Worthy	Very Worthy			
%	87.5%	75%	92%	100%			

Testing the prototype to the target user, namely prospective users using the System Usability Scale (SUS) to 5 potential users. After finding the results of the SUS questionnaire from 5 potential users, a SUS score will be calculated for each potential user. OnTable 5is SUS test data and obtained an average score of 82, where the value is included in grade A with excellent and acceptable categories or can be accepted by users.

Table 5.
Data SUS Test

Respondent	nt										Amount	Score (Amount x 2.5)
	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10		
R1	3	4	4	3	2	3	4	3	3	2	31	78
R2	3	4	3	3	3	4	3	4	4	1	32	80
R3	3	4	4	4	2	3	4	3	3	3	33	83
R4	3	4	4	4	3	4	4	3	3	2	34	85
R5	3	4	4	4	3	4	2	4	3	2	33	83
Average Score (Final Result)												82

IV. Conclusion

Based on the results of the research on Augmented Reality Application Design for Recognizing the Potential of Sudaji Village in Bali Using the Design Thinking Method, the following conclusions were obtained:

1. The development of the augmented reality application in Sudaji Village uses design thinking by going through several stages including gathering information (empathize), needs analysis (define), formulating solution ideas (ideate), making prototypes (prototype), and usability evaluation (testing).
2. The Sudaji Village augmented reality application has been validated by experts, where media experts and material experts each get an average percentage of 91% and 89.2%. Meanwhile, the results of application testing conducted on five users using SUS got an average score of 82 and was included in the excellent category and could be accepted by users. Based on the SUS results obtained, it can be concluded that the application is very good in terms of usability.

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