A participatory design approach to designing a playful cultural heritage experience

A case study of the Majapahit sites

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Abstract

A Participatory Design Approach to Designing a Playful Cultural Heritage Experience: A Case Study of the Majapahit Sites

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Within HCI, CSCW, and other related disciplines, participatory design has been proven to be an effective way of developing technological solutions where the end-users are involved throughout the design process. This study aims to find out how and to what extent can the participatory design approach be implemented and investigated involving the end-user perspective to enhance cultural heritage experience in a case study of the Majapahit sites. The process started with an initial understanding of the users and the user’s need via online pre-study involving 53 respondents. The insights gathered envision the possible attributes of design solutions, the visiting experience in Majapahit sites, and the participants’ relevant background. Three co-designing sessions with 35 participants were conducted, some needs and qualities were discussed based on the design process and the results of 11 design ideas from the design workshops. Later, to understand the usefulness and novelty of the identified design alternatives conducted from the workshops, further analysis of the design creativity was conducted with two experienced designers. The findings of the thesis involve five design areas in cultural heritage experience: improving the basic facility, support of learning about cultural heritage, assisting the visitor to explore the cultural heritage, social experience of cultural heritage, and support of entertainment and challenge in the cultural heritage experience. Hence, this study enables HCI researchers to do further study in regard to Majapahit sites or in the domain of cultural heritage in general.
Acknowledgements

This master study has been done thanks to Allah SWT for making everything possible, Special thanks to:

*My beloved one, for the great understanding and support.*
*My parent, family, and my beloved sisters, for their support and help.*
*My lovely friends, classmates, and the girls, for the thesis time and the fika study.*

A warm thanks to the guidance, support, and patience of Mikael Laaksoharju, who not only provided time and effort for tireless support throughout the thesis time, but also encouraged this research to happen. Tack så mycket! And also, thanks to Mats Lind for the time and insights to support as an experienced designer.

Thanks to Indonesian community and organization including Islamic University of Majapahit, Mojokerto; Cultural Heritage Conservation Center (BPCB) East Java, Directorate General of Culture; and Hasyim Asy’ari University, Jombang; for allowing me conducted the study in the respective places and all the support that I cannot mention one by one. Thanks to all of the contact person: Pak Lutfi, Pak Mohammad Ichwan, Pak Muhammad, and also Zukhruf for the advice, guidance, support, and patience. Thanks to all participants and respondents for sharing the experience, interesting insights, and thoughts.

All in all, this entire master study in Uppsala University and the master thesis had been reality and been remarkable experience thanks to the great scholarship by Indonesia Endowment Fund for Education (LPDP), Ministry of Finance, Republic Indonesia.

*Roisatul Azizah, May 2019*
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<td>SAPPhIRE</td>
<td>State change, action, part, phenomenon, input, organ, effect</td>
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<td>UNESCO</td>
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1 Introduction

Within HCI, CSCW, and other related disciplines, participatory design has been proven to be an effective way of developing technological solutions where the end-users are involved throughout the design process. There is a great deal of research using participatory design including co-design and co-creation to deepen the user involvement (Sitbon and Farhin, 2017; Ciolfi et al, 2016; Tsekleves et al, 2014). For example, Ciolfi et al (2016) examined how collaborative design processes can unfold a significance input in a respective context by reflecting two participatory processes. Moreover, Diaz et al (2016) discussed the benefit of unwitting participants to capture meaningful user experience while co-designing digital augmented cultural heritage exhibitions. The findings implied that participatory design can be performed in several ways and achieving different goals.

With a similar concern to the end-user perspective, but in a different technical implementation, gamification, persuasive technology, and immersive technology (such as augmented reality and virtual reality) have already been implemented to enhance visitors experience including preserving and raising awareness of cultural heritage sites (e.g. Hammady et al., 2016; Ibrahim et al., 2015; Bellotti et al., 2012; Bujari et al., 2017; Ardito et al., 2010; Kasomoulis et al., 2016; Basballe and Halskov, 2010; Diaz et al., 2018). These projects were mostly focused on the development of technologically-enhanced museum visiting experience rather than the outdoor cultural heritage sites. To support an engaging experience of visitors in a museum, Kasomoulis et al. (2016) implemented a 3D projection through personal mobile devices. Other discovered the success stories of gamification implementation to support the sustainable tourism (Negruşa et al., 2015). Additionally, Tsekleves et al (2014) used the participatory design approach, but not in a cultural heritage site. Tsekleves used the participatory design approach by collaborating with local communities of the respective field through playful engagement in a non-cultural heritage site context. Thus, it is clear, that playful experience has great potential to motivate people maintaining their engagement to a certain place.

A cultural heritage site that would benefit by an increase in visitor engagement is the Majapahit site. Based on the fifth report of Asia-Pacific Cultural Centre for UNESCO
(2010), "Majapahit Kingdom was one of the largest kingdoms in Indonesia between the 13th to 16th century AD." The heritage sites of Majapahit, which are also known as the Trowulan sites, are mostly located in the regency of Mojokerto. The site include temples, gateways, water structures, reservoirs, canal systems, construction elements, and various domestic tools. As Trowulan is the former capital of the Majapahit Empire, the world heritage list on UNESCO's official web page (2019) highlight its importance to Indonesia's historical and cultural journey of civilization. Therefore, the preservation of such cultural heritage site is crucial and this requires a massive collaboration among all stakeholders in Indonesia. However, there has been lack of conservation efforts using the participatory design approach with the end-user perspective to design a playful experience in cultural heritage on this Majapahit cultural heritage track.

1.1 Preliminary Research Question

This thesis aims to investigate the potential benefits of using the participatory design approach and identify user needs toward a playful cultural heritage experience of the Majapahit sites, with adults in Indonesia as the end-user. Connecting previous findings to the aim of this research, it is clear that the integration method of experience enhancement in cultural heritage have yet to be identified. The initial research question of this study is: \textit{Which design opportunities need to be implemented to enhance the user experience in cultural heritage using a participatory design approach in a case study of the Majapahit sites?}

1.2 Delimitations

In the context of user experience, this research focuses on the playful experience technique which have been proven to enhance the visitor experience. Playful experience is defined as a pleasant experience involving the gamification elements in its activities. With a wide scope of preserving a cultural heritage, this study needs to be on one particular case because of time and budget constraints, in this case, focus on Majapahit heritage track. Regarding the target users, this study aims to engage all stakeholders in the cultural heritage. The tourism employees or the staff of the cultural institution will also be invited to take part in the design process. The author will try to meet the requirement of the bureaucracy procedures. However, this administration situation is a concern of this study, thus the end result of such
involvement would depend on the time limit (see Time Plan in Appendix G) and how long the local authority would respond.

In regards to the ethical consideration, this study will gather informed consent from the participants. This means that the participants' identity will be anonymized and all the data gathered will be used only in the context of this research. A similar consent form will also be given to the tourism management office or the cultural organization involved in this study in regard to the selectiveness of the information publication.
2 Background and Theory

To further understand the importance of end-user perspective of the cultural heritage using participatory design approach, different academic backgrounds will be taken into account of such understanding. This chapter will discuss the recent and relevant studies in the domain of user experience in cultural heritage and the participatory design approach. In addition, a current research question and summary of contributions are presented by the end of this chapter.

2.1 Participatory Design

In their article, Fox and Le Dantec (2014) stated that participatory design (PD) practices can be developed to engage community members and those who are affected by technology should be involved in its design. Their initial aim was to explore different practices of civic engagement in a community, but later they reframed the workshop activities to give an immediate benefit and meaningful experience to the community members such as developing new skills and applying it in a new context. Also, they stated the important aspect of people involvement was the privilege to co-design and documenting its process. In addition, the activities they designed was a way to engage the local perspectives and to create opportunities for individual and collective empowerment.

Ciolfi et al. (2016) presented a reflection of two co-designing process with two different strategies for participatory development in the domain of cultural heritage. They unfolded two sets of co-designing activities with a different starting point, such as an open brief and create an initial working prototype; which will lead to different constraints and patterns of collaboration within the design team. The main goal of the project was to co-design a toolkit for a tangible interactive museum installation with a team consist of designers, cultural heritage professionals, social scientists and technology developers. It is clear that the process has both individual and group contribution. An interesting finding from their reflection on the process was the need to empower cultural heritage professionals to be actively engage as a designer rather than only as an informant. In the same vein, Diaz et al. (2016) discovered in their study of exploring digital futures for cultural heritage emphasized the users' contributions in the co-design processes. They defined that the participants as
co-creators should take an active role throughout the design process including ideation, design, and development new artifacts, which aligns with outcomes discussed in Barcellini et al. (2015). They stated that a valuable experience with a cultural heritage site or object is a very personal and subjective matter that cannot be shaped merely by asking the curators and the cultural managers.

Participatory design has been a useful design tool for the skilled workers (Kensing and Blomberg, 1998), one of which explore new insights and techniques for worker participation in a project called Utopia (1981-1984). Moreover, Kensing and Blomberg (1998) defined three basic requirements for participation in PD, 1) access to relevant information; 2) the possibility for taking an independent position on the problems; 3) participation in decision making. Also, two additional requirements including; 4) the availability of appropriate participatory development methods; and 5) room for alternative technical and/or organizational arrangement. As it is widely known in the area of PD, Kensing and Blomberg (1998) stated that mock-ups is a good way for designers and users to ‘experience the future’ in an inexpensive, understandable, and involve a hands-on experience.

Considering a different setting of PD, in the article by Grönvall and Kyng (2011), it is said that new possibilities and challenges emerge for participatory design in a different setting. By saying different setting, it is mean conducting PD in a setting where the worker or the participants might have mixed level of expertise and experience. In addition, the era of ICT and civic participation bring the challenges to have a sustained reflection and contribution in the social development in a PD (Smith et al., 2017). In the article "Design things and design thinking: contemporary participatory design challenges," Björgvinsson et al. (2012) stated that PD should be a collaborative effort where the design process is spread among diverse participating stakeholders and competences. They mentioned that one of the attempts to tackle the challenges of conducting PD with mixed setting would be focus on designing ‘things’ for social innovation and supporting ways to ‘design after design’. Which mean that the PD initiator and the organization in charge not only involving stakeholders as designers in the design process, but also toward future stakeholders as designers. This aligned with the statement that it is important to empower the participants to contribute as an individual in making decision rather than only focusing on achieving the project goal (Fox and Le Dantec, 2014; Ciolfi et al., 2016).
Radice (2014, p.110) described co-design as a process of collaborative design that consist of five phases that are intimately related in an iterative process. The five phases include: 1) first phase to explore the problem; 2) second phase to define the problem, for example a question such as what are other people's experiences or in what direction should we look for possible solutions?; 3) third phase to explore possible solutions based on the conceived problem, combination of perception and conception to enable participants to address questions such as how is this solution better than the current situation?; 4) four phase to implement and tried out the solutions by co-jointly generate solution that will work practically; and 5) five phase to evaluate the solutions, for example by negotiating different roles and interests of the designers in the iterative process. In this thesis context, these phases will be adjusted based on the initial understanding of the end-user, along with the consideration of five stages of design thinking process described by Interaction Design Foundation (Dam and Siang, 2019).

In the co-designing process, the researcher/designer takes on the role of a facilitator, for example by providing tools for ideation and expression, leading, guiding, and providing scaffolds to encourage people at all levels of creativity. Boy and Riedel (2009) stated that the facilitator should be a professional, for example by having a clear understanding of the users or co-designers and having the experience of working in interdisciplinary teams. Furthermore, Bødker and Kyng (2018) discussed that researchers in PD should behave not only paying attention to the ethical issues, but also acting fairly when involving users in projects. They noted that “more general understandings of quality of work has given way to specific users’ needs, as can be seen across the entire field of HCI.”

2.2 Playful Cultural Heritage Experience

Toward a playful cultural heritage experience can be related to the implementation of gamification in the domain of cultural heritage. Gamification technique defined as a persuasive technology with the element such as game mechanics and storytelling which perform an advantageous feature to support a pleasant experience (Orglia et al., 2016). This approach can be used both in the design process (e.g. Chakraborty et al., 2017) and in the technical implementation (e.g. Bujari et al., 2017). Orglia et al.
(2016) described a role of playful games is to build the curiosity of cultural heritage and attract people to cultural sites. They implement the elements of game mechanics such as character creation to build the enjoyment experience in cultural heritage. All in all, they stated that the effort needs to be aligned with the identification of curiosity aspect of personalized experience from the user perspective.

Involving the cultural heritage professionals (CHPs) in the designing of interactive technologies are increasingly growing in the recent years (Maye, 2017). CHPs including curators, museum directors, and education officers have essential contribution to deliver an intention to enhance the visitor experience. In the end-user perspective, Wang (2007) followed a user-centered design for personalized access to cultural heritage. Supporting that, Erik (2015), implementing a playful places with the local community participation as an essential element to uncover the hidden heritage with a massively multiplayer online games (MMOGs) called Ingress. It can be said that both CHPs and end-user perspective matter in the aim to support a pleasant and an engaging visitor experience.

2.3 Majapahit Heritage Track

The remains of Majapahit Kingdom located in the Regency of Mojokerto and Jombang, more specifically in the Districts of Trowulan and Sooko, and the Districts of Mojoagung and Mojowarno. The capital city of Majapahit located in Trowulan, so that the Majapahit heritage track was also known as Trowulan sites. Many building of Majapahit sites and remnants of human settlement have been maintained and utilized (UNESCO, 2009) including:

1. Mouse Tempel (Candi Tikus)
2. Gateway of Bajangratu (Candi Bajangratu)
3. Brahu Temple (Candi Brahu)
4. Gentong Temple (Candi Gentong)
5. Gateway of Wringinlawang (Candi Wringinlawang)
6. Kedaton Temple (Candi Kedaton)
7. Sentonorejo Settlement
8. Segaran Pond (Kolam Segaran)
In the context of this study, the term Majapahit sites includes all the eight building mentioned above in addition to Majapahit Museum in which thousands of artifacts are classified and utilized. Based on UNESCO (2009), the classified artifacts includes, 1) terracotta artifacts such as sculptures, domestic appliances, statue molds, and miniature houses; 2) ceramic artifacts such as plates, bowls, vases and spoons; 3) metal artifacts such as coins, bells, and mirror; and 4) stone artifacts such as relief and stone tablets.

Historians and experts (UNESCO, 2009) stated the authenticity and integrity of Majapahit sites or Trowulan sites can be seen in many significant values including:

1. An indispensable scientific value as a source of analogy to study the past
2. Relative and technical values. Majapahit sites show the evidence of an importance understanding of hydraulic technology such as the establishment of Segaran Pond, and high value of art in terms of concepts, techniques and methods that have been acquired by the ancestors of Indonesians in the past.
3. Strong identity and social values. This proved by the settlement located in Majapahit city that closely related to culture in later age such as Balinese culture.
4. Educational value including values of local wisdom that reflects the tradition to understand and balance culture with nature conservation
Based on the statement from UNESCO (2009), "the city pattern of Trowulan or Majapahit sites is the only comprehensive heritage site that can be found in Indonesia." All in all, Majapahit evidently was the center of the government by having a well-planned city and network of canals. Researchers interpreted that Trowulan was chosen as the capital city, one of which because of the numerous cultural heritages of aspect of livelihood both in term of sacral and profane. A further study to engage the local communities and cultural stakeholders was indeed relevant to support the awareness of the remaining sites of the former biggest and glorious kingdom in Indonesia.

2.4 Final Research Question and Contributions

Based on the preliminary research question for the current study, the final research question aims to address: How and to what extent can the participatory design approach be implemented and investigated involving the end-user perspective to enhance cultural heritage experience in a case study of the Majapahit sites?

To address the main research question, the key component of this study is separated into two main parts to investigate the following supporting questions: 1) Participatory design: What are the important aspects of participatory design in enhancing cultural heritage experience?; How to implement participatory design approach to engage the users participation? 2) End-user perspective in cultural heritage: What are the insights from the users to identify the user needs to enhance cultural heritage experience in a case study of the Majapahit sites?

By addressing the research problem, the thesis project aimed to contribute in the following ways:

1. Identify the user needs and the alternative qualities of design through the participatory design approach on enhancing user experience in Majapahit sites
2. Describe the context in which those extracting needs and qualities are investigated through the participatory design activities to enhance the user experience in Majapahit sites
3. Describe the design creativity assessment of ideas and solutions based on the participatory design results in the aspect of novelty and usefulness
4. Provide design insights based on those needs, qualities, and creativity assessment through a technological solution to enhance the user experience in Majapahit sites
3 Related work

3.1 Technological Solution in Cultural Heritage

*Mobile-based application for cultural heritage*

Several studies have been conducted to implement a technological solution to support the user in an engaging experience in a cultural heritage. Ardito et al. (2010) reusing various multimedia resources to produce a mobile application based on the type of users and devices. They provide educational games to support young students' learning while visiting some historical places in an amusing and pleasant way.

Suh et al. (2011) in their work entitled "Enhancing and evaluating users' social experience with a mobile phone guide applied to cultural heritage" indicated a significant user satisfaction within group experiences in a cultural heritage. They designed a mobile app with a sharing scheme of a mutual map's eavesdropping and audio content control. In the similar context of social sharing, Nguyen et al. (2017) identified and rated several historical places through smart tourism mobile applications and services to deliver an interaction between visitors by collecting and analyzing the geotagged multimedia data from social media.

All of these implementations of a technological solution were focus on mobile app development and require the user interaction via a mobile device. Yet, the development was focused on the users as informant rather than involving the users throughout the design process.

*Social recommendation services*

A successful factor of a cultural heritage exposition and its sustainability include improving the visitors' enjoyment and engagement (Hong et al., 2017; Manghisi et al., 2018). They enhanced user experience in a cultural heritage by different technological implementation. Hong et al. (2017) described that technologies are changing the role of cultural heritage in various actions to ensure the sustainability of its spaces. They discussed a technological solution to enjoy the artwork in a cultural site with a social recommendation service. It suggests the most appropriate cultural items to visitors are based on users' needs and preferences. Their suggestion designed and discussed in an architecture form based on three recommendation
methods such as combination of content-based, social-based, and context-based recommendation techniques. Manghisi et al. (2018) proposed a gesture-based interface to navigate a virtual tour on display walls with a case study of Mugia site. They conclude that their technical solution was successfully build interesting interaction for the users to spend their time enjoying the virtual visit of Murgia.

Wearables technology and location-based service
Brancati et al. (2017) investigated the benefit of the integration of wearable augmented reality to guide the users and provide an in-depth information on cultural heritage in a natural interaction, both indoor and outdoor environments. Their study was focused on the implementation of the technical side of human-machine interface to produce a reliable interface and interaction by using both depth and color data. This technical implementation resulted an interactive wearable AR system to augment the user environment with cultural information present in her/his surroundings with different scenarios such as various lighting conditions and fingertips feedback with different illumination conditions.

Bujari et al. (2017) implemented a digital technology using gamification to discover certain cultural heritage locations. By integrating a location-based and social recommendation service, Smirnov et al. (2017) developed an info-mobility system called Tourist Assistant (TAIS) to assist tourists in a cultural heritage with various supports (e.g. cultural heritage recommendation based on users’ preferences and the current situation in the region). With a similar design goal, Baker and Verstockt (2017) took advantage of mobile sensing and geotagging to develop a framework of recreational navigation platform called RouteYou’s to explore cultural heritage. Their research indicated the need to investigate the user expectation to optimize the user experience.

Overall, the technological implementation require in-depth understanding of the user needs to be able to produce a usable solution. It can be said that designing a solution to enhance the user experience should be based on the specific context of use. As explained above, for example, a simple and usable technology was proposed by Ardito et al. (2010), combining and reusing various multimedia sources to produce a supporting learning media. However, to the best of the author's knowledge, there has not been a prior work to understand both the users and user's
need that involves the end-user perspective throughout the design process, especially in the context of cultural heritage sites like Majapahit sites.
4 Methodology

This study used a qualitative approach to capture and analyze users' engagement throughout the design process. It began with understanding the requirements via literature review and a pre-study through an online survey, following with conducting design workshop which focuses on users as co-designers, analyzing the data and discussion of the design alternatives based on the user participation in the design workshop. The detail of each phase explained in the following section.

4.1 Understanding and Requirements Gathering

To understand the users and their experience of cultural heritage in an early phase, this study conducted a literature review and a pre-study.

Literature Review

A literature study was presented to gather useful inputs to understand the importance of user experience in a cultural heritage setting. Several of the most recent and relevant studies was discussed, including identifying and analyzing conservation and awareness of the cultural heritage, theories of the user experience in a cultural heritage, participatory design, and Majapahit heritage track (see Chapter 2). In addition, the technological solution in the relevant topic was investigated to understand different design alternatives based on the defined problem.

Pre-Study

The target users were both visitors or tourists, the local community, and tourism employees who have experienced the cultural heritage and live in Indonesia. The participants were young adults (18-35 years old) and middle-aged adults (36-55 years old). The reason for focusing on young adults and middle-aged adults was not only due to the significance of their perspective, which can give more useful insights (Boukas, 2008, p.219), but also based on availability and relevancy of their experience in the local community, tourism employees, and potential future visitors. The preliminary study was conducted to identify a general understanding of the visitor experience. This was done by conducting an online survey and contacting the tourism management office.
4.2 Participatory Design Approach

To work for and with the user perspective as the ‘experts’ of their own experience, this study uses a participatory design approach, particularly co-design. This approach was chosen to involve the user as co-designers. The term co-designer means that the result of this study was a collaborative work of the author who mainly acted as a facilitator to the end-user participation. With the user-centered design focus in mind, the main execution on this study focused on understanding the user and the user needs. Therefore, the participatory design involves the end-users with four main activities such as, a preliminary exercise, cultural probes, quality and assumption checklist, and the main design workshop using design thinking steps.

Preliminary Exercise

To bridge the way participants perceive creative thinking and to build creativity, as a study shows that people tend to think creative ability as an artistic ability (Beaty et al., 2018), the preliminary exercise was conducted as the first step of the design workshop (see Appendix A). This exercise was designed to get to know the participants and to emphasize that the workshop is not focused on the outcome but on the design process.

Cultural Probes

To understand the problem and to explore the current issue of the topic area, cultural probes technique was implemented. This method was chosen to explore the issue through an abstraction, such as by mapping and applying a self-reflection of the cultural heritage experience with a toolkit such as the imagination camera and sketching (see Appendix A).

Quality and Assumption Checklist

To identify the possible attributes of designs solution from the end-user perspective, the author created and presented the users with the list of assumption and relevant qualities of their good cultural heritage experience and some of the relevant qualities of a technological solution for cultural heritage (see Chapter 6.3). The purpose of implementing this method was to falsify that the author has the right idea of the problem area (Laaksoharju, 2014, p.114-116).
**User Design Workshop**

Throughout the design workshop with the end-user, Design Thinking steps (Dam and Siang, 2019) were implemented. This method was chosen to understand the real problem based on users’ perspective and to develop a step-by-step design solution based on their defined problem. The detailed procedure of design thinking steps explained in the design workshop section (see Chapter 6.2). This study involved stakeholders from different backgrounds, such as informatics, science, engineering, management, social, archeology, and history. Furthermore, to gain in-depth insight on the participants' final result on each design workshop, a video was recorded during the group presentation of their prototype along with their abstraction and notes.

**4.3 Analysis and Design Alternatives**

Based on the literature review, pre-study, and participatory design workshop activities, the user needs were analyzed by dividing them into a relevant category. The design creativity is assessed based on the results from the design workshops and summarized as the design insights to represent the core element of cultural heritage experience.

**User-Based Design Alternatives**

As part of the analysis, the author classified the results of the design workshop in different contexts of use. This categorization was chosen based on the connection between the extraction of needs and qualities of the problem area. Each category is presented with its supporting evidence both from the design workshop and the pre-study (see Chapter 6.7).

**Design Creativity Analysis**

To understand the usefulness of the identified design alternatives based on the users' participation, a further analysis of the creativity design was presented (see Chapter 7). This method assessed ideas or creative products through its relationship between the aspects of novelty and its usefulness. The novelty aspects refer to the comparability of an idea or a product to other available products in the market. While, the usefulness of 'ideas' and 'solutions' can be assessed using its level of importance, the rate of popularity of use, and the rate of use or the duration of benefit.
per usage using refined novelty assessment method (Jagtap, 2019, p.108; Sarkar and Chakrabarti, 2011, p.356). After identifying both aspects of novelty and usefulness, the author proposed the degree of creativity in the given set of design alternatives. However, due to the time limit and designers availability, the assessment was conducted in one pilot test with three designers and one real test with two experienced designers for not more than two hours sessions.

*Initial Design Insights*

By learning through the end-users designing process, while connecting the findings with previous researches and the design workshop documentation. Some of the initial design insights on developing a technological solution in the defined problem scope will be presented.
5 Pre-Study

The pre-study focused on the visiting experience of Majapahit sites via an online survey. The detailed explanation is in the following sections.

5.1 Participants

The initial study involved 53 participants (R1–R53) which composed of 26 females and 27 males with the average age of 24.37 years old (SD = 7.56). Participants’ field of expertise were varied that includes the technology-related field (16 participants), science and engineering (26 participants), social and management (5 participants), and history & archeology (6 participants).

5.2 Procedure

The participants completed an online survey with questions regarding the participants’ experience of visiting Majapahit sites. The survey questions were provided both in English and Indonesian language to give an easy understanding for the participants who speak Indonesian as the main language. The survey had three parts: First, (1) an introduction of participants age, gender, and field of expertise. Secondly, (2) the participants were asked several questions related to the Majapahit sites, such as which sites of Majapahit they have visited, when was the last time they visited the Majapahit sites, how many times they have visited the Majapahit sites, and why they chose to visit the Majapahit sites. Lastly, (3) the participants were optionally asked regarding the use of technology to support or enjoy their previous visits to cultural sites, as well as to imagine what kind of technology they want to create beyond the technical limitation to improve such experience. The detailed results of each part will be explained in the following section.

5.3 Results and Analysis

Based on the survey (shown in Figure 2), it can be seen that Candi Tikus was visited by more respondents than the other sites, followed by Candi Brahu, Segaran Pond and Pendopo Agung which have a similar number of a visit by the respondents.
As shown in Figure 3, 52.8% of the respondents have visited Majapahit sites ranged from one to three times, while 35.8% visited the Majapahit sites from four to six times. Interestingly, about 7.5% of the respondents visited the Majapahit sites for more than 20 times. With this information in mind, the author was able to expect some different experiences of each respondent based on how many times they visit the Majapahit sites.

Regarding when the last time respondents visited the Majapahit sites, not more than half of the respondents have visited the sites of more than a year ago (see Figure 4). Approximately 22% of the respondents have visited the Majapahit sites within a month ago. Regardless of when the last time the respondents visited Majapahit sites,
their experience can be relevant to the user design workshop because there is no significance renovation or changed from the sites.

![Pie chart showing the last time respondents visited Majapahit sites](image)

*Figure 4. Survey on the respondents’ latest visiting time*

Overall, the result of the survey provided some insights from the end-user on how the workshop design should be conducted. For example, by understanding that some sites are more popular than the others (e.g. Candi Tikus), in the facilitation phase, certain site can be mentioned as an example.

The reasons to visit some Majapahit sites over the others can be identified into four themes: (1) knowing or learning the history, (2) recreational purpose, (3) enjoying the heritage building, and (4) work-related visits (shown in Figure 5).

![Bar chart showing reasons for visiting Majapahit sites](image)

*Figure 5. Reasons for visiting Majapahit sites*
The first reason of visit for around half (56%) of the respondents' intention was to learn and understand the Majapahit story and its historical value.

"...the site is historic and can be a motivation that in Java island (where the sites located), especially in Mojokerto there was a civilization in the form of a kingdom that once triumphed in its time." - R1

Second reason of visit of about 24% of the respondents who went to Majapahit sites with their family or friends for a recreational purpose. R14 specifically mentioned that it was the exact reason for his/her visit to the Majapahit sites with his/her friends. In the same vein, R47 mentioned another reason was because the sites are near her/his place.

"Because the Majapahit royal site is a historical heritage site closest to where I live." - R47

Thirdly, enjoying the heritage buildings such as temples building and the view surrounding it. About 12% respondents visited Majapahit sites to enjoy the temple’s architecture and the scenery around it, which included the rice field with mountain views and park with flowers. To be more precise, R7 stated a reason is to understand the legacy of Majapahit kingdom, especially the architecture of the temples.

Lastly, about 10% of the respondents visited Majapahit sites because of their profession, but not only to work, two respondents (R11, R12) were there for both work and enjoying the heritage sites or the Majapahit collection.

Regarding the aspects that can be improved to enhance cultural experience based on the respondents' survey (shown in Figure 6), half of the respondents wanted to have more experience in learning about the cultural heritage. As this question was presented in a multi-selection format, about 15% of respondents wanted both learn more about cultural heritage and more exploration and discovery of the cultural heritage to enhance their visiting experience. For example, R52 explained that "The Majapahit temples show that the Majapahit kingdom was so majestic." In the improving the entertainment aspects of the cultural heritage and better social experience, about 20% of respondents were concerned about this. Having said that, these four aspects of improvement were aligned with the intention to visit the Majapahit sites. To be more precise, while the major intention to visit Majapahit sites was to know and understand the historical story and its value, most respondents
agreed that the learning aspects of the cultural heritage can be improved to enhance their cultural experience.

Figure 6. Aspects of improvement

In the last part of the pre-study, some insights were gained from the respondents about their imagination of what kind of experience they would like to have if they can create any technological solution without limitations. Firstly, was to have the quality solution that are touchable, such as a touchscreen visualization or having an immersive experience by implementing a Virtual Reality technology, 5 respondents wanted to implement a 3D simulation of Majapahit sites especially the temples as the object.

"...making architecture or 3D visualization with Majapahit temples as the main object" - R1
"...display in the form of 3D temples along with information, information with a touchscreen display, etc." - R19
"...creating a 3D miniature of Majapahit sites along with VR feature to learn about all Majapahit sites." - R36

Second, 14 respondents were interested to introduce the Majapahit sites in different ways. For example, R21 wanted to create an app to show the Majapahit site in an easy way. Some respondents (e.g. R31, R39) did not specify which form of technology to build the design solution, however they focused on emphasizing on the function is to get to know the Majapahit sites easily.

"...creating information about Majapahit sites beyond the text and through visualization." - R25
"...developing something to show each site's collection" - R29
Meanwhile, two respondents (R24, R38) emphasized the feature of sharing the experience, while communicating with other people as one of the important qualities of a design solution. Finally, based on the survey result was that more than 80% of the respondents were interested to visit Majapahit sites again.

5.4 Limitation of the Pre-Study

The number of respondents of pre-study might be limited to get significant results (53 respondents) due to the short time range for about three weeks for potential respondents to complete the survey. In addition, only 22.6% of respondents have recently visited the Majapahit sites, the rest of respondents have visited the sites for more than a month ago. However, their feedback of visiting experience was relevant because there has not been much maintenance or renovation on the cultural sites.
6 User Design Workshop

6.1 Participants
In total, 35 participants took part in a four-hour design workshop, consisted of 13 females and 22 males, with a mean age of 24.42 years old (SD = 8.38). Participants came from different fields of expertise including the technology-related fields (11 participants), science and engineering (15 participants), social and management (4 participants), and history & archeology (5 participants). They were recruited through different approaches, including direct personal approach, local community social media group, university information and the government office of culture. They received 'fika’ or snack, and food, but no financial compensation in return for their participation. About 71.4% of the participants were nearby residents living around the heritage sites, while 28.6% of the others came from other cities in which they reside in the current area to study or work. All participants were required to have visited the Majapahit sites to take part in the study.

6.2 Procedure
The design workshops were conducted in the Indonesian language to enable an easy communication. However, some instruments were prepared in English or in bilingual (English-Indonesia). The author served as a facilitator. The design workshops were held in three different schedules based on the end-users’ available time as it was held in a long hour which started from 9.30 am until 3 pm.

Before starting the main design workshop, the author conducted a preliminary exercise for the participants to introduce what is design workshop, how it is done, and to bridge the way participants’ perceive creative thinking and to unlock their potential insights and thoughts. The outcome of the preliminary exercise enabled the author to get to know the participants and understand their expectations. The detailed steps can be seen in Appendix A.

The steps of design workshop used five phases of Design Thinking including Empathize, Define, Ideate, Prototype, and Test. (1) The objective of the Empathize phase was to build user's empathy and gain an understanding of the problem area.
The author used a cultural probe as an approach in this phase. Following with, (2) the Define phase, by doing mind mapping and data processing to identify and define the core problems. Then, (3) the Ideate phase, where the participants were asked to imagine and visualize the ideal user experience of a selected problem based on the group discussion. In this phase, the participants focused on ideating multiple solutions. After that, (4) the Prototype phase, to facilitate the participants building and creating the solution for the defined problem. Finally, (5) the Test phase, to let participants present their idea and getting feedback on a mock-up design from the other groups. The User Design Workshop agenda is presented in Appendix B.

After the design workshops were conducted, the author collected 11 videos in a total of 11 low-fidelity prototype presentation from three design workshop sessions. The videos were transcribed and translated into English. The videos were filmed to capture the participants’ prototype presentation along with their abstraction and some notes during the workshop for further analysis. The information was coded to gather the defined problem and the designed solution of each group which provided an insight into the end-user's perspective as the 'experts' of their own experience. In these following details, the results from each design workshop was presented. To have a consistent identity and maintain the anonymity, the author assigned group identification with an ordered number (Group 1-11). For example, the group name of the second design workshop is the following number from the previous design workshop (see Table 1).

<table>
<thead>
<tr>
<th>Session</th>
<th>Number of Participants</th>
<th>Group Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design Workshop 1</td>
<td>15</td>
<td>Group 1, Group 2, Group 3, Group 4</td>
</tr>
<tr>
<td>Design Workshop 2</td>
<td>12</td>
<td>Group 5, Group 6, Group 7, Group 8, Group 9</td>
</tr>
<tr>
<td>Design Workshop 3</td>
<td>8</td>
<td>Group 10, Group 11</td>
</tr>
</tbody>
</table>

*Table 1. Group Numbering*
6.3 Results of Survey on the Possible Attributes of Design Solutions

To identify the possible attributes to design a solution for enhancing cultural heritage experience, 34 participants took part in a survey. It is originally 35 respondents as part of design workshops, one response was discarded due to technical issue. The respondents were provided with a list of possible attributes based on a literature search. The participants could answer with yes (agree), no (not agree), and maybe (neutral). Some list includes the assumption related to Majapahit sites experience (see Figure 7), relevant qualities of a good cultural heritage experience, and relevant qualities of a technological solution for cultural heritage (Figure 8). For example, the technology should help visitors understand the cultural value of the heritage sites, the technology should help visitors to share their experiences with others, the technology should be easy to use and help visitors locate the cultural heritage sites.

![Figure 7. Result of Survey on the Assumption](image)
The results of the preliminary study enabled the author to envision possible attribute of designing a technological solution for enhancing the user experience of visiting cultural heritage, specifically Majapahit sites.

Relevant assumptions on the problem area of enhancing cultural heritage experience and participatory design:

A1, Participatory design has been proven to be an effective way of developing technological solutions

A2, A technological solution can help to preserve and to raise awareness of cultural heritage

A3, A playful experience can influence the number of visitors in cultural heritage sites

A4, Gamification has been successfully implemented to support sustainable tourism

A5, Playful experience has been shown to be one important factor for enhancing the visitor experience

A6, Visitors who feel engaged with a place are more likely to both return and promote the place

A7, Users are most likely to visit cultural heritage with somebody

A8, Some cultural heritage sites of Majapahit are more popular than others

A9, Some people find it difficult to find the exact location of some of the Majapahit sites
All stakeholders, including tourists, tourism officers, and the local community, can design a meaningful solution for preserving the remains of the past cultural heritage.

Relevant qualities of good cultural heritage experience and relevant qualities of a technological solution for cultural heritage:

Q1, Engage the visitor to keep the cultural heritage
Q2, Learn something related to cultural heritage
Q3, Trigger the visitor to promote the cultural heritage
Q4, Usable for outdoor cultural heritage
Q5, Accessible to every visitor
Q6, Easy to use
Q7, Portable
Q8, Do not require new (expensive) infrastructure
Q9, Focuses attention toward the cultural heritage site
Q10, Help visitors understand the cultural value of the cultural heritage site
Q11, Help visitors locate cultural heritage sites
Q12, Help visitors decide which sites to visit
Q13, Help in involving the local community in the visitor’s experience
Q14, Do not lead to negative effects for the local community and the cultural heritage sites
Q15, Help visitors to share their experiences with others

It is interesting to notice that more than half of participants agree with A9 statement, however two of the groups (Group 5 and 6) in the design workshop were focused on some kind of tour-guide ideation to help visitors enjoy the Majapahit sites. Meanwhile, the qualities that can be extracted from these ideas were includes Q7, Q2, Q5, and Q11.

The most appealing result shown in Figure 7 is that all the participants agree that the qualities of technological solution in cultural heritage should help visitors to understand the cultural value of the heritage sites. To be more precise, for example, Group 1 stated that visitors should know the history of Majapahit after their visit. Another supporting argument from Group 10 stated that by knowing the history of the establishment of the Majapahit kingdom, the visitors should be more enthusiastic about Majapahit sites. It can be said that the qualities underlying the user needs of
learning cultural heritage is an easy way to access the relevant information (Q6, Q1). Interestingly, in the technological perspective, both groups were focused on providing an animated film which show in a different form of media such as pen and paper.

6.4 Result of First Design Workshop

The first design workshop was conducted at a university in Jombang with 15 participants (4 female and 11 male). The participants were divided into 4 groups which have different defined problem and solutions.

What the author found according to Group 1 was that some basic facility needs to be improved to provide a more comfortable experience to visitors. As written in their abstraction in the brainstorming phase, the facilities that they were concerned about such as the location of recycle bin, the lack of parking area, and the cleanliness of the toilet. With some of these problem areas in mind, Group 1 decided to focus on improving the parking facility. The feelings of comfort and cost efficiency were the primary reasons for them to produce the solution.

"...This system designed for customized costs. So, costs during holidays and weekdays are the same. Because usually, parking fees during holidays are twice as expensive as can be anticipated with this system..." - G1

![Figure 9. Group 1 with the Parking Concept](image)

All in all, from the Group 1 perspective, to improve the user experience in cultural heritage, the first and foremost problem that needs to be tackled is related to facility or infrastructure. Group 1 designed a prototype of the parking lot ‘house’ for each temple. The parking area was designed like a house building (Figure 9) which have the automatic door and consistent price per day. Having said that, transparency of facilities or services price and information is one of the important qualities of design solution based on Group 1.
The author found that the participants had different perspectives toward enhancing user experience in cultural heritage. From Group 2's perspective, understanding the history of Majapahit was their main need to satisfy their cultural experience. Based on their own goal to visit Majapahit to learn the history, they created a prototype of the 3D cinema room (Figure 10) with a focus on the animation or film about Majapahit history. The need that underlies this design alternative was that most visitors still lack knowledge about Majapahit even after visiting its sites.

"...a prototype of a historical application that we want to tell about the temples in question (a legacy of Majapahit). Usually, most visitors might not know about the history of Majapahit. So, we created a 3D cinema..."

![Figure 10. 3D Cinema Room by Group 2](image)

On the other hand, in the perspective of Group 3, the need to enhance cultural heritage experience should be solved with a complete package of solution. As they were concerned most about the need to learn Majapahit history and its location, the designed solution (Figure 11) was in the form of an application with a focus on Majapahit sites information including the history, the heritage location, and the photograph.

![Figure 11. Majapahit Storyline by Group 3](image)

Group 3 argue that the application must have a complete feature to support them and other visitors enjoying Majapahit sites. In their written abstraction, the quality of the solution includes explaining the history of a specific temple and information that contains the location of a particular temple.
Later, Group 4 was focusing on implementing gamification in their design alternative as they believe that providing an entertaining service to the visitors like them is necessary. They define themselves as visitors who like to solve a challenge while learning things. Their design goal was to help visitors to have the nuance of a historical story in an immersive experience. Their scenario includes when visitors entering the historical attractions, their general information (e.g. age, favorite game) should have been recorded and have been directed to the heritage paths based on the preference of the place so that they really leave memories/impressions from the beginning to the end of every site. Additionally, they stated that user satisfaction can be achieved by all players of the game whether they lose or win the game.

"...When visitors are given AR, visitors can see a reality in Majapahit which contains sites of heritage from the old-time. Visitors will see some oddities such as cats that can talk or others in the age of miracles. Then you can see workers in the village who are hoeing and others..." - Group 4

Group 4 prototype was made of cardboard (Figure 12) which represent the Augmented Reality headset (e.g. glasses, mask, treasure box). One of the main qualities of the game was the old-time setting and some challenges or adventures.

6.5 Result of Second Design Workshop

In the second design workshop, 12 participants (5 female and 7 male) were divided into 3 big groups and later into 5 small groups. This session took place in a university in Mojokerto, which is a city where most Majapahit sites are located. The design process of each group explained in the following text.

Based on Group 5, one of the important needs for them as visitors was to know the flow of where to go when visiting Majapahit sites while seeing a short documentary at some points. The qualities that underlying their design alternatives were easy to
access to historical information (e.g. through a smartphone), a warm welcome to first
comer visitors, a timeline of the historical sites, and guiding the visitors who need
help to know some heritage places.

"...Tour Guide app will be escorted to visit the temple then invited to the photo
gallery containing the history of Majapahit, then will be invited to see a short
documentary in the mini cinema and finally, visitors will be escorted to a souvenir
place to shop." - Group 5

Group 5 given a name of their prototype as Tour Guide app, it focuses on giving
guidance on Majapahit temples. They presented the prototype using paper media
(Figure 13) with a storyline of how to use the design solution. They stated that the
idea was inspired by a tour guide service to visit some tourism place but in an app
mode. The needs that can be extracted from this design alternatives were the need
of availability of a guide that can be portable or easy to access, the need to have an
instant recommendation of what to do and how to do it in an instant way, and the
need to be with a buddy to ask for a certain opinion regarding the sites.

Similar to the previous group, Group 6 was also focused on providing guidance for
the visitor, the difference was that the content of the designed prototype. Group 6
explained their solution as a complete guide of Majapahit sites. They named it as
Go-Guide which provide information on all temples history. The information provided
in an app platform that displays each Majapahit site by selecting a certain menu.

Meanwhile, Group 7 and Group 8 focused on enhancing the social aspect of cultural
experience. With this aspect in mind, they have similar design alternative which
focuses on promoting Majapahit sites through the different social media platforms.
They stated that explaining Majapahit history via an online platform would suit the
young generation these days. While Group 7 idea of promoting Majapahit sites
through a social media which focus on sharing photos and short videos to the wider
audience, Group 8 concept is in a form of vlogger with special theme regarding the area around the temple. The need that can be extracted from the design process of both groups was related to raising awareness of cultural heritage sites that would satisfy the user one of which through the existence of the heritage sites in social media platform. Not only focus on promoting the sites but also providing the information of Majapahit history in a simple way (e.g. picture, short video).

The next group (Group 9) focused on providing an interactive solution where the visitor can feel the Majapahit sites by touching a 3D simulation. They stated that by being able to touch the temple, the visitor can feel closer to the sites. In other words, Group 9 idea of Majapahit simulation app allows the user to experience 3D features of Majapahit temples along with audio-visual and ancient backgrounds

"...the application is interactive and can change the appearance of the temple simulation according to the path that the user enters. In this application, there are 3D features, temple simulations, and audio-visual designs with ancient backgrounds." - Group 9

6.6 Result of Third Design Workshop

The third design workshop was conducted in Majapahit Museum, an archaeological museum which is located in the former Capital City of Majapahit, Trowulan, Mojokerto. There were 8 participants (4 female and 4 male) took part in the session, six of the participants were an employee of the Majapahit Information Center Division and two of the participants were from the local community. Participants were divided into 2 groups with mixed background and field of expertise.

In the early phase of the design process, both groups were asked to explore the type of activities that (they as) visitor usually do while visiting Majapahit sites. Based on Group 10, there were four main categories of visiting activities including recreation, collection, religion, and observation. (1) Recreation means that the visitors decided to go to Majapahit sites to have a relaxing day such as recreation, strolling, accompanying students tour, taking pictures. (2) Collection activities such as seeing the uniqueness of statues (Figure 14), knowing the Majapahit capital, cultural experience, asking for the building name, seeing the museum collection and the collection information. (3) Religion category was an activity of worship, looking for something magical, and looking for the tomb of the king of Majapahit. And (4) Observation mean by silently watching, asking about the collection, asking
information of Majapahit museum, asking about the royal inscriptions, looking for a reference for batik design, and seeking the king of Majapahit statue.

*Figure 14. Participants were sharing about Majapahit collection called 'Kendi'*

After brainstorming the activities using the end-user perspective, the author facilitates the participants to step back and write down what kind of attempts that they have been done as a stakeholder of Majapahit sites. Group 10 divided their attempts to enhance the visitor experience in three categories (Figure 15). (1) Education, they have been done some attempt in the form of events such as creative corner for kids, educational events such as competition, and art performances. Meanwhile, they are hoping to provide a diorama room for the screening of Majapahit films as part of improving the visitor experience in this category. (2) The facility, they have been provided the visitor with some facilities including collection room, children area, and categorization of the collection in the museum. And hoping to build some facilities including Majapahit culinary cafe, big screen about Majapahit, audio-visual information fo Majapahit sites, photo area, children playground, digital voice information of Majapahit, and charger corner. (3) Cultural, they have been done the attempt that staff should be friendly to the visitors and add insight into cultural collections while hoping for traditional dance and art performance to add experience and satisfy the visitors.
Further, Group 10 chose one aspect in the form of greeting the visitors with an animated film of the establishment of the Majapahit kingdom. The underlying need for this design alternative was to understand Majapahit history in an interesting way. Group 10 hope that visitors can be more enthusiastic to explore Majapahit site after watching the film. Some quotes from Group 10 presentation follows.

"...the history of the establishment of the Majapahit kingdom in the form of an animated film that hopes visitors can be more enthusiastic about the establishment of the Majapahit kingdom. The storyline begins with the ruins of buildings damaged by war, how the kingdom of Singosari destroyed and how Raden Wijaya was protected by several other kings. Raden Wijaya's next step was to devote himself to the people and take refuge in Madura. Then Raden Wijaya become Daelabang’s slaves and received a land of power. The story is in a historical book. Next, the ‘army’ came to invade Kediri. The picture was like that until a war broke out even though they were initially friends. So that Raden Wijaya can establish the Majapahit kingdom..." - Group 10

Findings from Group 11 includes the different activities of visiting Majapahit sites and the museum. Group 11 divided some activities and reasons to visit Majapahit sites in six categories such as ideology, art, social, education, recreation, and economy. (1) Ideology: ritual, worship, look for magical. (2) Art: photography, art ideation, seeing the temple building, seeing the temple. (3) Social: organization or community event, strolling with kids, gathering, looking for inspiration, meeting the loved one, pre-wedding photo session. (4) Education: looking for Majapahit information, research activity, learn about Majapahit history, assignment of history subject, curious. (5) Recreation: strolling, playing with family. (6) Economy: fishing, selling things around.
What can be learned from the attempt that Group 11 members that have been done to enhance the visitor experiences, can be categorized into three main points. (1) Event, they have been done some event such as a workshop in the art and culture and hoping to socialize about Majapahit sites to students, designing a pamphlet, and provide an event facility for the local community. (2) Facility, they have built a replica of Majapahit sites and designed a kid’s corner. And hoping to have a clean area, wider park area, photo corner, automatic cleaning machine, making a diorama of Majapahit history, and a larger area for kids. (3) Application, they have created a documentary film of Majapahit sites but because of certain circumstances, the film was not successfully published. So that they hope for a big screen with a 3D model of Majapahit temples and audio-visual room to play the documentary film.

In the end, Group 11 decided to focus on a big screen idea which provides information about Majapahit sites or temples including some 3D simulation and temple photos from different angles.

6.7 Limitation of the User Design Workshop

The design workshops were conducted in three different places in accordance with the place availability and the registered participants’ schedule. The participation was mostly male participants (22 out of 35). However, the imbalance of gender presentation was beyond expectation because the author has invited all the potential participants without any gender limitation (see Chapter 6.1).

As the user design workshop was conducted in Indonesia, the activities were conducted in the Indonesian language because the participants feel more comfortable to communicate in their native language. However, some list of attributes and additional instruments were provided in bilingual (English-Indonesia) to support both the author and the participants convenience.

Another limitation of the design workshop might be that the Empathize session of the third design workshop was a bit different from the first and the second design workshop (see Appendix A). This is due to the fact that some participant roles were as the stakeholder or tourism employee of the Majapahit sites. Similarly, the user
experience mapping was implemented only in the first design workshop due to the time limit and the fact that the Emphasize phase was covered enough to move on to the Define phase. Due to the time limit and the need to focus on the design process, the last phase of the design workshop was partly implemented, the concept of the polishing idea (see Appendix A) was only presented to the participants without the actual implementation on their ideas or prototypes.
7 Design Creativity Analysis

7.1 Participants and Procedure

The objective of the design creativity analysis was to understand the novelty and usefulness aspect of the users' participation outcome and to gain valuable insight from the experienced designers on the current result of design workshops. In other words, the goal of the design creativity analysis was to check whether the design workshops lead to creative solutions.

Three designers took part in the pilot test of design creativity analysis. These designers constructed the initial SAPPHiRE model (Sarkar and Chakrabarti, 2011, p.354) and rank of novelty and usefulness in computer-based environment (see detail results in Appendix F). The author gain valuable input from the pilot test including in which way the test can be performed (individual or in a team), how much detail description of ideas needed for the designer to do the assessment, and the understanding of rank based on the designers intuitive notion and relevant references. In the real test, two experienced designers was provided with the printed description of ideas and solution (based on Chapter 6.4-6.6), the assessment materials (see Appendix F) including the redefined novelty assessment method (Jagtap, 2019), SAPPHiRE model, and table of level of importance (Sarkar and Chakrabarti, 2011). All designers were recruited in person, the participation was voluntary, and the assessment took about an hour to one and a half hours session.

7.2 Result of Design Creativity Analysis

Based on the experienced designers' intuitive notion, the result of design creativity assessment is presented in Table 2. As explained in the previous section (see Chapter 4.3), this assessment was also intended to have other designers' input of the design alternatives based on the design workshops sessions. This assessment was not merely focusing on evaluating the outcome or product ideas of design workshop, but more to have the state of changes for 'ideas' assessment with a focus on the advantages of the end-users or visitors of Majapahit sites.
<table>
<thead>
<tr>
<th>Product sets</th>
<th>Groups and 'Ideas' name</th>
<th>Novelty rank</th>
<th>Usefulness rank</th>
<th>Creativity value = Novelty × Usefulness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Improving facility</td>
<td>Group 1: Parking lot</td>
<td>5</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Group 2: 3D room</td>
<td>5</td>
<td>4.5</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Group 11: Big screen of animated film</td>
<td>5</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Learning about cultural heritage</td>
<td>Group 3: Majapahit learning app</td>
<td>5</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Group 9: Majapahit 3D simulation</td>
<td>1</td>
<td>3.5</td>
<td>2</td>
</tr>
<tr>
<td>Assisting the visitor to explore and discover the cultural sites</td>
<td>Group 5: Tour-guide app</td>
<td>5</td>
<td>4.3</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Group 6: Go-guide app</td>
<td>5</td>
<td>4.3</td>
<td>5</td>
</tr>
<tr>
<td>Social experience of cultural heritage</td>
<td>Group 7: Sharing experience via photo platform</td>
<td>5</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Group 8: Sharing experience via video platform</td>
<td>5</td>
<td>4.5</td>
<td>5</td>
</tr>
<tr>
<td>Entertaining and challenging cultural heritage experience</td>
<td>Group 4: Majapahit adventure game with AR tech</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Group 10: Animated film of Majapahit establishment</td>
<td>5</td>
<td>5</td>
<td>5</td>
</tr>
</tbody>
</table>

**Table 2. Design Creativity assessment ranking (average)**

It is important to note that Table 2 shows average novelty and usefulness ranks, these are not scores but Rank (1 high, 5 low).


<table>
<thead>
<tr>
<th>about cultural heritage</th>
<th>app</th>
<th>Usefulness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group 9: Majapahit 3D simulation</td>
<td>0.5 1 300 0.0013</td>
<td></td>
</tr>
<tr>
<td>Assisting the visitor to explore and discover the cultural sites</td>
<td>Group 5: Tour-guide app</td>
<td>0.3 1.5 250 0.0009</td>
</tr>
<tr>
<td>Group 6: Go-guide app</td>
<td>0.3 1.5 250 0.0009</td>
<td></td>
</tr>
<tr>
<td>Social experience of cultural heritage</td>
<td>Group 7: Sharing experience via photo platform</td>
<td>0.4 1 600 0.0020</td>
</tr>
<tr>
<td>Group 8: Sharing experience via video platform</td>
<td>0.2 1 400 0.0007</td>
<td></td>
</tr>
<tr>
<td>Entertaining and challenging cultural heritage experience</td>
<td>Group 4: Majapahit adventure game with AR tech</td>
<td>0.4 1 100 0.0003</td>
</tr>
<tr>
<td>Group 10: Animated film of Majapahit establishment</td>
<td>0.1 1 600 0.0005</td>
<td></td>
</tr>
</tbody>
</table>

Table 3. Usefulness analysis

It is important to note that the rate of use and rate of popularity were generated based on the pilot test. The Usefulness using Equation was generated based on the formula discussed in Sarkar and Chakrabarti (2011, p.363).

7.3 Limitation of Design Creativity Analysis

The author decided to use the latest redefined novelty assessment method (Jagtap, 2019) that have been discussed to fill the gap of deficiencies in design creativity analysis which previously discussed by Sarkar and Chakrabarti (2011). This method was widely used in terms of product assessment, however, it might be need to redefine the use of method in terms of assessing novelty of ideas or solutions. To this extent, it is important to note that this study did not focus to evaluate the design creativity method but rather implemented it based on the context of use. Another limitation would be related to the auto generated number of usefulness rank in which supposed to be manually inputted by the experience designers. Due time limitation, the usefulness rank was auto generated based on the experienced designers' input on the level of importance of use with regard to adjusted rate of popularity of use and rate of use from the pilot test.
8 Discussion

8.1 Discussion of Participatory Design Approach

User-Based Design Alternatives / Insights of the user needs

Based on the design process in the design workshop with end-user, the insight of the user needs can be identified into five categories. The investigated needs were identified (1) to improve the basic facility, (2) support of learning about cultural heritage, (3) assisting the visitor to explore the cultural heritage, (4) support of social experience of cultural heritage, and (5) support of entertainment and challenge in the cultural heritage experience.

First, in the context of improving basic facility such as parking lot was the focus of Group 1. Meanwhile, Group 2 and Group 11 also defined the design alternatives to add facilities such as a 3D room and a big screen of the animated film of Majapahit.

Second, in the context of learning about cultural heritage, three groups (Group 3, 4, 7) were discussed a similar solution by developing an app/web to provide Majapahit history in an interactive way.

Third, in the context of assisting the visitor to explore and discover the cultural heritage area, Group 5 and Group 6 defined the design opportunities by developing an app to guide the visitor (tour guide).

Fourth, in the context of the social experience of cultural heritage, Group 7 and Group 8 focused on promoting Majapahit via social media (e.g. Instagram and Youtube) as an attempt to raise the awareness of the cultural heritage and get to know the sites.

Fifth, in the context of entertaining and challenging cultural heritage experience, Group 4 and Group 9 presented their designed solution in which AR and 3D technology were used. While the animated film of Majapahit sites history was chosen by Group 2 and Group 10 to get the vibe of challenging historical story.
**Development of user's roles to engage the participation**

Regarding the analysis of roles of participation of the author and the participants, it can be defined into two hierarchy. First, the author, as both designer and facilitator. The design workshop was planned and facilitated by the author. Second, the participants, depending on the tasks the participants was performed as a group and individual in both roles as designers and end-users. To have the interactive group performance, the author divided the participants from different fields of expertise and level of heritage experience (e.g. measured by the frequency of visiting Majapahit sites). Barcellini et al. (2015, p.32) defined the four type of role based on goal and descriptors including interacting role, group-oriented role, task-oriented role and production role. Aligned with this type, the author prepared tasks to be finished within the group and individually.

### 8.2 Discussion of Designing for Cultural Heritage Experience

*Initial qualities of a technological solution in cultural heritage*

Connecting the results of the survey on possible attributes of relevant qualities (see Chapter 6.3) with the findings from the design workshop process (see Chapter 6.4-6.6), the initial qualities of a technological solution in cultural heritage was identified. One of the important qualities of the technological solution is that the technology should help visitors understand the cultural value of the heritage sites, this quality was supported by evidence (e.g. the storyline from one of the groups focus on the establishment of Majapahit Kingdom). This is also supported by the result of the pre-study (see R1 quote in Chapter 5.3). However, to satisfy the user needs, the design solution should not only show the history of Majapahit Kingdom but also having sufficient interaction and feedback (see Chapter 6). The type of interaction can be classified in two-way interactions and natural interaction. Two-way interactions when the user is able to communicate with the technology in certain ways and natural interaction based on the context (e.g. old-historic setting, animation, adventurous, etc.). The feedback mentioned by users such as audio-visual, touch, and haptic.

*Defining a cultural heritage experience*

What can be learned from the process of co-designing session with end-user was that the participant has four main reasons to visit Majapahit (see Chapter 5.3) including knowing or learning the history, vacation purpose, enjoying the heritage building, and profession. This is connected to the result of the survey on the possible
attributes of good qualities that interestingly has been agreed by all the participants, helps visitors understand the cultural value of the cultural heritage site. This finding triggers the author to illustrate the cultural heritage experience based on the conducted study (see Figure 16).

![Illustration of design areas in cultural heritage experience based on the users' design alternatives](image)

Figure 16. Illustration of design areas in cultural heritage experience based on the users' design alternatives

Overall, as can be seen in Figure 16, the design areas of cultural heritage experience involves learning its history, basic facilities fulfillment, social sharing, explore the sites, and a challenging environment. These five areas build upon the discussion of needs and qualities that underlying the users satisfaction in terms of enhancing their cultural experience (see Chapter 6.7). Depending on the context of use, these five areas can be both independent aspect or complementary criteria of designing for cultural heritage experience. However, these five areas always open for future modification and input from the further studies especially in the case of Majapahit sites.

8.3 Discussion of Design Creativity Analysis

During the assessment process, the two experienced designers agreed that the participants of cultural heritage experience and field of expertise affected the collaboration within the team. For example, the idea of Majapahit adventure game with AR tech by Group 4 was affected by the input of participants' favorite game and average age of the team members.

As can be seen in Table 2, the Group 9 ideas of Majapahit 3D simulation has the highest rank of creativity value based on the two experienced designers' notion. The
interesting take out from this idea was that experience designers defined 'touch' as both new feature in cultural heritage but it can also be a challenge in terms of the implementation. In addition to the findings from Group 9 (see Chapter 6.5) the designers thought of some additional features such as gloves with the vibrators and haptic feedback. For example, it can give the visually impaired people could have the new experience of an outdoor heritage sites to an interactive indoor simulation using an additional artefact such as gloves to support an interactive feedback. In the overall creativity assessment, the idea of Group 4 also getting attention from the designers. The underlying need of this idea was focusing on providing a challenge to the users. They defined an old-time setting to display the historical attractions, a winning and losing scheme to satisfy the user, and additional fictional stories to attract the users especially young people.

In the aspect of usefulness (see Table 3), Group 1 idea of improving basic facility in a form of parking lot was considered as useful but not novel. This can be understood as Group 1 describe that user experience on visiting can be improved by achieving the basic needs of the sites infrastructure while in parallel focusing on the community involvement. Meanwhile, the experienced designers agreed that Group 7 sharing experience via photo platform as a way to cover the needs of the users to express their awareness of cultural heritage via a social platform. This social platform sharing considered as the current popular way especially for young people to share information while contributing virtually in terms of content or information production.

Overall, it is important to use the results of the design workshops as input for design rather than as solutions that can be implemented directly. The design creative analysis also contributed in a way that experienced designers discussing the results of 11 design ideas from the design workshops using their design intuition.
9 Conclusion

9.1 Conclusions

Regarding the research question, "How and to what extent can the participatory design approach be implemented and investigated involving the end-user perspective to enhance cultural heritage experience in a case study of the Majapahit sites?", it can be drawn into two parts. First, the investigation of participatory design approach which aimed to focus on understanding the users and the user’s needs. To gain an initial understanding of visiting experience in Majapahit sites, a pre-study with 53 respondents has been conducted and analyzed. Thanks to the insights gathered from the pre-study, the author was able to envision the general understanding of the end-user visiting experience, relevant background to support the participation, and some degree of expectation regarding how to get to know them and what to do in a certain situation.

Second, the implementation of designing with end-user. Based on the results of co-designing with 35 participants in three design workshop sessions, the user needs were classified into five categories. First, improving the basic facility, for example the need to give a comfort for the visitor, a parking lot idea was presented with the quality such as transparency of information. Second, support of learning about cultural heritage, there is a high tendency from the end-user to gain values after visiting Majapahit sites and one of the qualities to satisfy the user in this aspect is an interactive scenario of the historical story. Third, assisting the visitor to explore the cultural heritage, one of the identified needs in this aspect was that the end-user can have a real time guidance that are portable and easy to access. Fourth, support of social experience in cultural heritage, the need giving a content contribution to a certain cultural site was underlying this aspect, for example by promoting the sites in a simple way such as photo sharing and short video sharing. Finally, support of entertainment and challenge in the cultural heritage experience, this aspect was identified as a general insight from the overall users' perspective where the need to appreciate the history of Majapahit sites one of which was come back to the old-time setting.
One appealing results of the qualities of technological solution in cultural heritage is that it should help visitors to understand the cultural value of the heritage sites. Having said that, the design creativity analysis indicated that the users are more likely to design a solution in regard to their preference activity, background and age, which means that the aspect of usefulness were taking into consideration more than the novelty aspect of design.

9.2 Limitation of the Present Thesis and Future Work

The first limitation of the present study was the limited number of users from historical background in the first and second design workshops. This is a limitation as Ciolfi et al. (2016) suggested that the involvement of users with strong historical expertise could benefit to participatory design process. In this case, users were more likely to expressed similar opinions without having the detail knowledge of the heritage sites aside from their own visiting experience. However, from a user-centered design perspective, the involvement of end-users from any background could be a strength rather than a limitation. The strategy to involve the historians was not applied from the beginning due to the bureaucracy process. So that, in the later research, it would strongly recommend to start the project in collaboration both with the cultural institution and the local community.

In the reality of the co-designing session with the end-users, different challenges might arise depending on the level of the end-users experience and expertise. Thanks to the result of pre-study which provide information such as visitors experience in Majapahit sites and the user field of expertise. However, this might not be enough for a novice designer to make a fast decision in every surprising situation. Meanwhile, understanding what to do in what situation based on the theoretical approach and in a practical situation could be a different case. This limitation would lead to a suggestion of a pilot session of a design workshop in the future study. The pilot session can be done among the peer with some certain scenario involves. It might not that relevant if the study was in collaboration with expert designers and the suggestion might not related to the research question but rather a general insight that can be learned from the process of conducting the design workshops.

Due to the scope and time limitations, the third limitation of this study is that it has not been implemented the user needs in regard to develop a prototype. In response
to this limitation, narrowing down the needs and the qualities presented in this thesis would benefit to the development of a technological solution for the future work. In addition, observations of space and place could be a good complement in the understanding phase of the cultural sites.

Having said that, it could be interesting to continue the study of cultural heritage experience in detail in the aspect of human-agent interaction. For example, in the context of smart chatbot and voice assistant, it could be possible to design a heritage experience that will also need to apply the cultural heritage knowledge and end-user perspective which discussed in this study such as performing certain feedback, to get better results.

To sum up, there is a lot to do to enhance the user experience in the domain of cultural heritage. Almost in every country in the world has their own uniqueness which reframe a different perspective from the end-user and the challenge to understand the needs is big, but so that the opportunity to fill the gap of the present knowledge and achieve a better design goal.
References


http://link.springer.com/10.1007/978-3-319-45841-0_17 (January 5, 2019).


Appendix

Appendix A
User Design Workshop Detail Plan

Agenda

- **Introduction (20")**
  - Fika time: get to know each other and group forming (put a sticky note with a name on it)
  - Welcoming and thanking the participants for their time and willingness
  - Informed consent form signing
  - A brief explanation of the thesis topic and purpose of the design workshop
  - Make sure the participant filling the pre-study one-day before the design workshop: [http://bit.ly/Majapahitsurvey](http://bit.ly/Majapahitsurvey)
  - General instructions of the materials used, timing, and teamwork during the workshop
  - Asking the participants if they are ready or have any questions
  - Team up: different discipline;
- **Empathize; Define; Ideate phase (50"; 40"; 20")**
- **Lunchtime (50")**
- **Ideate (cont. 10"); Prototype; Test phase (50"; 40")**
- **Gratitude and invitation for semi-structured interviews with five randomly selected participants (5")**

Introduction question:

- How many of you have experienced design workshop?
- How many of you heard about design thinking or participatory design?
- How many of you have work with pen and paper to show idea you have in mind?

Preliminary exercise:

- How many of you here think that you are creative?
- 45 second to draw a portrait of the neighbor (*rumah idaman #PD3*)
- How does that feel?
- What is it feel good or bad? Did I give you much time?
- Purpose: to bridge the way participants perceive creative thinking and to unlock their potential (as study shows that people tend to think creative ability as an artistic ability); it's about how you collaborate; share what you are good at; we are not focused on outcome but on the process; willingness to take on new thing whether you can draw or not; we believe that everybody has creative inside them (creative confident).
● Quick sketching exercise (10s): door; house; mountain; innovation (light bulb?). *Meja, sofa, pemandangan, kreatifitas.*
● How you are guys feeling? Do you have any questions? or Are you ready?

Notes: PD1 stand for First Design Workshop, PD2 stand for Second Design Workshop, etc.

Empathize
Create user empathy and gain an understanding of the problem area

Cultural probes:
● Explore the issue through abstraction
  ○ Mapping: using stickers to map the environment of the Majapahit sites (focus on the places) (material: A3 paper, 2 colors of sticky note)
    ■ Sketching Majapahit area *(implemented in PD1 and PD2)*
    ■ Sketching what can remember when talking about Majapahit
  ○ Workbook: understanding the situation by filling the blank of questions related to the research area (material: print out the quality and assumption checklist)
● Self-reflection within the interaction with the toolkit
  ○ Imagination Camera: creating sketches to tell a specific moment of the user while visiting the sites (material: A4 paper, marker, pen/pencil color)
    ■ Foto imagination camera *(implemented PD1 and PD2)*
  ○ User experience mapping: creating a storyboard of either positive and negative moments; personal stories when things become difficult or enjoyable (focus on the experience; a point of interaction)(material: print out the template; pen/pencil, sticky note) → *apa saja yang dilakukan saat mengunjungi situs majapahit? (implemented in PD1)*

Define
Mind mapping and data processing to identify and define the core problems

Activities:
● Identify problems based on the insight gained from Empathize phase
  ○ Focus on identifying problems and the causes of it (remind the participant to not jump into the solution-oriented yet)
● Brainstorming the participants' problem in mind
  ○ Writing it down in sticky note (one note, one idea; start from solo, in-pair, to team)
  ○ What you like and dislike? What activities do you usually do?
  ○ What is already good and what needs to be improved?
  ○ What kind of effort or attempt that you have been done to improve the user experience of visiting Majapahit sites *(Only implemented in PD3)*
Categorizing the similar identified problems within the small team
  ○ Share the discussed problem in the small team to the big team and writing down the identified problems in the cupboard/slide

Define a problem statement (one or more?) write the point of view statement?

Each group sharing their problem statement to the class

Questions:
- Why do we need to enhance the user experience?
- Why do we need to preserve and raise awareness of cultural heritage?
- What the real problems really are?
- What is the problem in more concrete?
- 5 why questions?
- What kind of needs that they want to feel?
- Remind them about four aspects of the pre-study about learning, etc..
- How you thought of…
- How do you feel about…
- What do you think causes…
- Can you describe how…
- What are the causes of…

Aspects to think about based on the literature review, for reference:
- Technology-enhanced cultural heritage learning
- Explore and discover cultural heritage track
- Gamification implementation in the cultural heritage experience
- A social experience in cultural heritage journey

Ideate

Imagining and visualizing the user ideal experience from selected problem based on the group discussion; Ideating multiple solutions

Activities:
- Brainstorming ideas based on end-user needs, thinking of the problem area to solve (note: quantity over quality; the best way to get the best idea is to have a lot of ideas; don't judge anyone ideas; as wild as possible; solo, in-pair)
- Sharing ideas with others within the small team and get feedback
- Illustrating the ideal experience of cultural heritage (imagination beyond any technological limitation) (narrative/storyboard/sketching/mind mapping)
- Creative thinking process; sketch up your best ideas

Questions:
● How could you deliver the cultural value without having to...
● What would you need to have or eliminate in order to accomplish this?
● What would you change in Majapahit experience to improve the engaging feeling and become more beneficial for you?
● In which situations do you think those improvements are most useful?
● Do you think there are specific moments in which you would like to have those improvements?
● How we might improve the experience of older adults in Majapahit' sites?
● How we might improve the experience of children in Majapahit' sites?
● How we might improve the experience of young people in Majapahit' sites?

Prototype
Building and creating problem solutions (in-pair)

Type of prototyping:
- Sketch
- Storyline
- Storyboard
- Mock-up prototype

Activities:
- Hands-on experience
- Innovation is a process

Materials:
- 4 scissors, 2 types of glue, 2 rulers, cardboard cardstock, post-it notes 2 pads, masking tape, foam?

Questions:
- How do your ideas fit in the context of the actual cultural heritage experience?

Test
Getting feedback on the mock-up design from the other users; use some testing tools

Activities:
- Presenting the idea to other teams to get feedback and vice versa (sharing idea and design critique session)
- Iterative actions: polishing idea with Six Thinking Hat method (tentative; not implemented)

Six thinking hats questions:
- White hat - Facts
  - What do we know?
- What do we need to know?
- How do we get this information?

- Red hat - Feelings
  - What are my gut feelings?

- Black hat - Cautions
  - What are the difficulties and weaknesses?

- Yellow hat - Benefits
  - What are the strengths and opportunities?

- Green hat - Creativity
  - Any new ideas?
  - Any new opportunities of problem to solve?
  - How can it be improved?

- Blue hat - Process
  - What’s been learned?
  - What’s next?
## Appendix B

### User Design Workshop Agenda

<table>
<thead>
<tr>
<th>Date</th>
<th>17; 27; 28 March 2019</th>
</tr>
</thead>
<tbody>
<tr>
<td>Place</td>
<td>UNHASY; UNIM; Museum Majapahit</td>
</tr>
<tr>
<td>Participants</td>
<td>35</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Time</th>
<th>Duration (mins)</th>
<th>Main Activities</th>
<th>Materials</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>09.30 - 10.00</td>
<td>30</td>
<td>Welcoming participants</td>
<td>Fika; Consent form</td>
<td>Setting the table with the equipment (sticky notes, pen, etc.)</td>
</tr>
<tr>
<td>10.00 - 10.20</td>
<td>20</td>
<td>Introduction</td>
<td>PPT, Videos, A4, pencil</td>
<td></td>
</tr>
<tr>
<td>10.20 - 11.10</td>
<td>50</td>
<td>Empathize phase</td>
<td></td>
<td>Collect the participants' artifacts from this phase afterward</td>
</tr>
<tr>
<td></td>
<td>15</td>
<td>- Mapping</td>
<td>A3 paper, 2 colors of sticky note</td>
<td></td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>- Workbook</td>
<td>Print out the quality and assumption checklist</td>
<td></td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>- Imagination Camera</td>
<td>A4 paper, marker, pen/pencil color, camera toolkit</td>
<td>Sketching specific 2-3 moments</td>
</tr>
<tr>
<td></td>
<td>15</td>
<td>- User Journey</td>
<td>Print out the template; pen/pencil, sticky note</td>
<td>Mapping customer journey which focuses on experience after the Mapping phase which focuses on places</td>
</tr>
<tr>
<td>11.10 - 11.50</td>
<td>40</td>
<td>Define phase</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>15</td>
<td>- Brainstorming problems and causes (solo, in-pair, and team)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>15</td>
<td>- Categorizing/mind mapping</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>- Defining a problem statement</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11.50 - 12.10</td>
<td>30</td>
<td>Ideate phase</td>
<td></td>
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<tr>
<td>Time</td>
<td>Activity</td>
<td>Details</td>
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<tr>
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<td>------------------------------------</td>
<td>-------------------------------------------------------------------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Brainstorming ideas (solo and team)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Sharing ideas (team)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Sketching ideas</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12:10 - 13:00</td>
<td>Lunchtime</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13:00 - 14:00</td>
<td>Sketching (cont.)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14:00 - 14:50</td>
<td>Prototyping</td>
<td>4 scissors, 2 types of glue, 2 rulers, cardstock, post-it notes 2 pads, masking tape, lego?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>14:50 - 15:00</td>
<td>Test phase</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>30</td>
<td>Presenting ideas</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>Polishing idea</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Closing and thanking participants</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Question-Answers (if need)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Presented format of the design workshop agenda:

Design Workshop

Introduction
Empathize
Prototype
Detail
Test

What is design workshop?

Empathize
- Mapping
- Workbook
- User Journey

Define
- Identifying problems and causes (ethnography, in-person, and online)
- Creating empathy mappings
- Defining, prioritizing statements

Ideate
- Brainstorming ideas (both online and in-person)
- Sharing ideas (board and sketching)

Prototyping
- Sketching ideas to help visualize, test, and iterate

Test
- Prototyping ideas
- Polishing ideas

Thanks!
Any questions?
You can reach me at [email protected] & [email protected]
One of the three posters of the design workshops:
Appendix C
Pre-Study

End-User Participation (Pre-Study)

Thank you for taking part in this survey.

Up to 20 participants from different background will be invited to join in one of the three sessions of a four hour design workshop. The participation is voluntary, however, we offer some facilities including snack, drink, lunch, and special vouchers for some random lucky participants.

This survey is part of a master thesis research about designing a playful cultural heritage experience (study case of Majapahit sites, Indonesia). If you have visited the temples (Candi Brak, Candi Tikus, Candi Bajang Ratu, etc) or any other Majapahit heritage trail, your participation would be very much appreciated. You’ll only need approximately 10 minutes to do so and your identity will be anonymous.

If you have any question regarding this, feel free to contact me on email: riuutul.azizah.847N@student.uu.se

Email address *
Valid email address

Phone number
(Optional: if you want to join the random free gift for 7 lucky participants)

Gender *

- Male
- Female

Age *

Short answer text

Field of Expertise *

- Information Technology
- Social
- Science
- History
- Engineering
- Other

City of origin

Short answer text
Visiting Experience

Which sites of Majapahit have you visited? Multiple option can be selected

☐ Candi Bisnu
☐ Candi Gentong
☐ Candi Banyang Putu
☐ Candi Tikus
☐ Sepahan Pool
☐ Candi Menak Jingga
☐ Perdopo Agung
☐ Wring Lewang
☐ Other...

When was the last time you visited Majapahit sites?

(When terakhir kali Anda mengunjungi situs Kekaisaran Majapahit)

1. A month ago
2. 2 months ago
3. 3 months ago
4. 4 months ago
5. 5 months ago
6. 6 months ago
7. More than 6 months ago
8. More than a year ago

Approximately, how many times have you visited Majapahit sites in total?

(Kira-kira, berapa kali Anda telah mengunjungi situs Kerajaan Majapahit)

1. 1 to 3 times
2. 4 to 6 times
3. 7 to 10 times
4. 11 to 20 times
5. More than 20 times
Why did you choose to visit Majapahit sites? *(Jelaskan apa saja alasan Anda memilih untuk mengunjungi situs Kerajaan Majapahit)*

Long answer text

Based on your previous experience, did you feel any need to enhance your visiting experience? If so, in which aspect?

(Berdasarkan pengalaman kunjungan Anda, aspek apakah Anda harapkan untuk meningkatkan pengalaman berkunjung di situs budaya Majapahit)

☐ More learning about cultural heritage (Memahami situs budaya lebih lanjut)
☐ More exploration and discovery of cultural heritage (Lihat lebih banyak tempat di situs budaya)
☐ More entertaining and challenging cultural heritage experience (Pengalaman seru dan menegangkan saat berkunjung)
☐ Better social experience during cultural heritage journey (Mendapatkan pengalaman berinteraksi sosial di situs budaya)
☐ other...

In your previous visit, did you use any technology to support or enjoy your visit? If so, what kind of technology?

(Apa teknologi yang Anda gunakan untuk mendukung atau menikmati kunjungan Anda? Jika ya, apa jenis teknologi yang Anda gunakan?)

Long answer text

Imagine that you can create any technological thing you want. What experience would you like to have when you visit Majapahit sites with that technology?

(Bayangkan jika Anda bisa menciptakan teknologi apa saja. Apa pengalaman yang Anda inginkan ketika Anda mengunjungi situs Majapahit?)

Long answer text

On a scale of 1-5, how interested are you to visit Majapahit sites again? *(Dari skala 1-5, seberapa besar keinginan Anda untuk mengunjungi situs Majapahit lagi)*

1 2 3 4 5

Not interested at all Very interested

Feel free to tell us more why you would like to participate in the design workshop

(Jangan sungkan untuk memberi tahu kami lebih lanjut mengenai alasan Anda ingin berpartisipasi pada design workshop)

Long answer text
Appendix D

Information Sheet and Consent form: Design Workshop

You are invited to participate in a thesis study on "A participatory design approach to designing a playful cultural heritage experience, a study case of the Majapahit sites" part of Master Programme in Human-Computer Interaction, Uppsala University, Sweden. The aim of this design workshop is to investigate end-users envision toward the design of engaging cultural heritage experience.

Student in charge: Roisatul Azizah   | Signature: ........................... | Date: 16 Maret 2019

The study will approximately take four hours and your participation in this study is voluntary. You are free to choose whether or not you will take part in the study. You have the right to withdraw from the study at any time, including withdrawal of any information provided.

The following material will be collected during the study for further analysis:
1. Design probe artifacts
2. Documentation
3. Observations/notes

The researchers will be recording the participation design process by taking note, taking pictures and collecting the design probe artifacts (mapping, workbook, camera sketch, and user journey mapping). The data will be used by the researchers conducting the study to analyze your design process. Participants cannot take part without being documented. After taking part in the study, you are free to withdraw your data, by emailing one of the study researchers within seven days of the study being completed. If you decide to withdraw, your data will be removed and destroyed.

All collected data will be treated as confidential and stored securely. Documentation, written notes, and audios will not contain any identifying information about you. All collected data will be anonymized. Only the researchers of the study will be granted access to the data for legitimate research purposes. We may show pictures or documentation of our study in scientific papers, conferences, and events, but only if you agree on this by giving your consent below.

Statements of Understanding and Consent

- I have read and understood the participant form, and I have had the opportunity to ask questions if necessary and have had these answered satisfactorily
- I understand that my participation is voluntary
- I understand that the data and recordings collected in this study will be used as detailed in the participant information form
- I agree to be audio recorded during the study
- I agree to participate in this study, and I consent to the publication of the results of the study with the understanding that anonymity will be preserved

Name ______________________  Signature ___________________Date: 17 March 2019

Additionally, by signing below I agree that audio and data recorded during my participation in the study can be used in scientific papers, conferences, and events

Signature ...............................................................................Date: 17 March 2019
Appendix E

Video Presentation Transcription

Group 1
Filename: VID_20190317_152629.mp4


We will explain our prototype about parking design to be located around the temple. You can see this design box. The details can be seen in the following miniature. Here there is a car, motorcycle and parking lot for other vehicles. To enter the parking lot there is an automatic portal with a system such as a toll with electronic tickets using a card then a new vehicle can enter and park in the available place. Placed semi-open parking is available triangular roof. This system designed for customized costs. So costs during holidays and weekdays are the same. Because usually, parking fees during holidays are twice as expensive as can be anticipated with this system. For security extended with a barbed wire placed on the side of the building. Such is the presentation from our group.

(Explaining the prototype of parking lot design for each temple)

Group 2
Filename: VID_20190317_152230.mp4

71

We made a prototype of a historical application that we want to tell about the temples in question (a legacy of Majapahit). Usually, most visitors might not know about the history of Majapahit. So, we created a 3D cinema. This facility will be operated with the package payment, later on, can be included in the entrance ticket. So, the visitor can pay for the entrance ticket and then pay when we want to enjoy the cinema. With the package system, visitors will feel bad if they don't use the available cinema facilities. The goal of this prototype is that with this cinema, visitors will come home with something that is knowledge about Majapahit. When entering the cinema, the history of some Majapahit relics will be displayed.

(Explaining the prototype of a 3D cinema room with a focus on the animation or film about Majapahit history)

**Group 3**

**Filename: VID_20190317_151321.mp4**

I will explain the application that we made. So the application has a lot of options, including history, location plans, photographs. Now we will try one of the applications, the photo feature. Visitors can use the mouse available to select the desired feature. The choice of features can be seen in our work. After being clicked, for example, the photo feature, the temple images will appear in Trowulan. There are several images of temples in Trowulan that visitors can enjoy.

(Explaining about prototype of an application with a focus on Majapahit sites information including the history, the heritage location, and the photograph)
Disini kami akan mempresentasikan hasil karya kami yakni Gamification. Kami akan membuat simulasi pengunjung ketika memasuki tempat wisata seolah-olah sedang bermain dengan fasilitas 3D. Kegiatan yang akan dilakukan pengunjung yaitu ketika memasuki gerbang pengunjung akan diberikan sebuah alat yang Namanya AR. AR ini sebuah teknologi yang bisa bergabung dengan AR yang lain. Ketika pengunjung diberikan AR pengunjung dapat melihat sebuah realita di Majapahit yang berisi situs-situs peninggalan Majapahit.

Here we will present the results of our work namely Gamification. We will simulate visitors when entering tourist attractions as if playing with 3D facilities. activities that will be carried out by visitors, namely when entering the gate, visitors will be given a tool called AR. AR is a technology that can join other ARs. When visitors are given AR, visitors can see a reality in Majapahit which contains sites of heritage from Majapahit. Visitors will see some oddities such as cats that can talk or others in the age of miracles. Then you can see workers in the village who are hoeing and others. When visitors arrive somewhere before entering one of the sites, visitors will be entertained with buto (monster) creatures. Visitors must try to defeat the monster, but it is unfortunate if the power is low. Furthermore, visitors will be given a notification to strengthen themselves against Buto. Then visitors must look for a treasure. There are five treasures to look for. If everything is collected, the power will be stronger. Temple mapping relief for Gamification is not placed anywhere, only placed on sites in Majapahit. When the player arrives at one of the eating sites, he will get a treasure and get a relief containing puzzles. The puzzles are about the history of how one of them was made or standing. In one puzzle there are words as instructions. The show if it examined will be a complete word. When it is up to five, it will get a sentence or step. Then if it is said then the power-up will rise. When the trip on several sites is finished, visitors will defeat the monster again before leaving the game. So as long as players search for relief
there are still challenges on every road. After defeating the last monster, visitors will receive a prize of congratulations. Maybe here the concept of the story is still simple. But all the game player stories, both win and lose, will still be satisfying. But our work is hoped to be wrapped up by programmers who would create an interesting technology. This game has choices for children and for adults.

(Explaining about the prototype of Augmented Reality game with the setting of old times and some challenge or adventures)

**Group 5**
*Filename: IMG_0837.MOV*

Pengunjung yang datang bersama aplikasi tour guide akan diantar mengunjungi candi kemudian diajak ke dalam galeri foto yang berisi sejarah Majapahit, selanjutnya akan diajak melihat film dokumenter singkat dalam bioskop mini dan yang terakhir pengunjung akan diantar ke tempat souvenir untuk berbelanja.

(Menjelaskan mengenai guidance pada Situs Majapahit dengan menggunakan media kertas)

Visitors who come along with the Tour Guide app will be escorted to visit the temple then invited to the photo gallery containing the history of Majapahit, then will be invited to see a short documentary in the mini cinema and finally, visitors will be escorted to a souvenir place to shop.

(Explaining the guidance on Majapahit Temple using paper media)

**Group 6**
*Filename: IMG_0837.MOV*


(Explaining about the prototype of Augmented Reality game with the setting of old times and some challenge or adventures)
We designed a prototype called Go-Guide. Visitors can enter a certain website to install the application. When opening the application, there are several menu choices, for example, the user selects the "Candi Tikus" menu, then click "History" then there will be a display of the temple's history, then click "back" and so on.

(Explanation of the Go-Guide application, using paper media)

Group 7
Filename: IMG_0838.MOV

Berikut rancangan ide kami yang berfokus untuk mempromosikan situs kerajaan Majapahit melalui sosial media. Dimulai dengan membuka Instagram, lalu pilih menu upload video atau foto. Hasil upload-an akan menjadi feed, feed akan dapat di repost oleh pengguna lain sebagai sarana promosi majapahit sites.

The following is the design of our idea that focuses on promoting the Majapahit royal site through social media. Starting with opening Instagram, then selecting the uploaded video or photo menu. The upload will be a feed, the feed will be reposted by other users as a means of promoting Majapahit sites.

(Explaining the idea of promoting Majapahit sites through social media by sharing photos and videos to the wider audience)

Group 8
Filename: IMG_0839.MOV

Ide kami tentang Vlogger unik terkait situs Majapahit. Vlogger dengan konten obrak-abrik candi. Langkah pertama yaitu masuk ke youtube kemudian pilih salah satu video. Ada 2 jenis vlogger, yang pertama yaitu vlogger dengan tampilan tampak depan ada juga yang merekam dengan kamera yang
Setelah penjelasan dari vlogger akan diputarkan sebuah video mengenai candi tersebut yang telah melewati proses editing agar hasilnya menjadi lebih maksimal.
(Penjelasan vlogger candi mengenai daerah sekitar candi dengan menggunakan media kertas)

Our idea of Vlogger is providing something unique about Majapahit sites. Vlogger took focuses on the temple scrambling content. The first step is to go to Youtube then select one of the videos. There are 2 types of Vloggers, the first is a vlogger with a front view, some also record with a camera. After the explanation of the vlogger, a video will be played about the temple that has gone through the editing process so that the results become more optimal.
(Explanation of the concept of Vlogger regarding the area around the temple using paper media)

**Group 9**
*Filename: IMG_0840.MOV*

Disini kami akan menjelaskan tentang perancangan aplikasi simulasi Majapahit yang kami buat. Pada aplikasi ini terdapat mouse yang digunakan untuk memperbesar suatu area dan icon camera untuk masuk pada area tertentu, selanjutnya terdapat penjelasan mengenai candi beserta deskripsinya. Kemudian aplikasi bersifat interaktif dan dapat berganti tampilan simulasi candi sesuai alur yang masukkan pengguna. Pada aplikasi ini terdapat fitur 3D, simulasi candi dan audio-visual dengan desain berlatar zaman dahulu.

Here we will explain the design of the Majapahit simulation application that we made. In this application there is a mouse that is used to enlarge an area and a camera icon to enter a certain area, then there is an explanation of the temple and its description. Then the application is interactive and can change the appearance of the temple simulation according to the path that the user enters. In this application, there are 3D features, temple simulations, and audio-visual designs with ancient backgrounds.

(Explaining the idea of Majapahit simulation app which allows the user to experience 3D features of Majapahit's temple along with audio-visual and ancient backgrounds)

**Group 10**
*Filename: IMG_0892.MOV*

We will explain about the prototype of the application of the history of the establishment of the Majapahit kingdom in the form of an animated film that hopes visitors can be more enthusiastic about the establishment of the Majapahit kingdom. The storyline begins with the ruins of buildings damaged by war, how the kingdom of Singosari destroyed and how Raden Wijaya was protected by several other kings. Raden Wijaya’s next step was to devote himself to the people and take refuge in Madura. Then Raden Wijaya slaves to Daelabang so that he is given a kind of land of power. The story is in a historical book. Next, the Tar-tar army came to invade Kediri. The picture was like that until a war broke out even though they were initially friends. So that Raden Wijaya can establish the Majapahit kingdom. That's the general picture. The preparation is done with the aim of visitors getting an overview of the historical events of Majapahit.

(Explaining the concept of the animated film of the establishment of the Majapahit kingdom)

Group 11
Filename: IMG_0893.MOV


We collaborated to make a 3D prototype of the screen containing the temples in Trowulan and its information. The steps that we made: (1) Collecting information in the form of data about temples that will be made a 3D screen, so the hope is that visitors who have limited time don't have to come to the temple but can see the temple through this screen. Data collected in the form of literature data, old reports, interviews, internet, and others. (2) Temple photos from several sides (top, side, front, back). (3) After the collected data and photos are made in the 3D version with the max studio application or another.

The appearance of the temple can rotate and the color is adjusted to the original. So that visitors who see like seeing the original temple and can imagine based on the image seen. The example on the Wringin Lawang temple image visitors will see 3D images like the original and on the side of the picture contains information about the temple.

(Explanation of a big screen idea which provides information about Majapahit sites or temples including some 3D simulation and temple photos from different angles)
Appendix F
Design Creativity Assessment Materials and Result of Pilot Test

Materials
1. Refined novelty assessment method (Jagtap, 2019, p.108)
2. SAPPhIRE Model (Sarkar and Chakrabarti, 2005, p.354)

1. **Phenomenon**: interaction between system and its environment.
2. **State change**: change in property of the system (and environment) that is involved in interaction.
3. **Effect**: principle that governs interaction.
4. **Action**: abstract description or high-level interpretation of interaction.
5. **Input**: physical quantity (material, energy or information) that comes from outside the system boundary, and is essential for interaction.
6. **Organs**: properties and conditions of system and environment required for interaction.
7. **Parts**: physical elements and interfaces that constitute system and environment.

3. Level of importance of different products (Sarkar and Chakrabarti, 2011, p.360)

<table>
<thead>
<tr>
<th>Code</th>
<th>Points in a scale of 5</th>
<th>Level of importance</th>
<th>Type of importance</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>5 (&gt;4.0–5.0)</td>
<td>Extreme importance</td>
<td>Life saving drugs, life support systems</td>
<td>Oxygen cylinder, pace makers</td>
</tr>
<tr>
<td>B</td>
<td>4 (&gt;3.0–4.0)</td>
<td>Very high importance</td>
<td>Compulsory daily activities</td>
<td>Taking food, using restroom</td>
</tr>
<tr>
<td>C</td>
<td>3 (&gt;2.0–3.0)</td>
<td>High importance</td>
<td>Shelter, social interaction</td>
<td>Pen, belt, clothes, housing, spectacles, shoes</td>
</tr>
<tr>
<td>D</td>
<td>2 (&gt;1.0–2.0)</td>
<td>Medium importance</td>
<td>Machines for daily needs</td>
<td>Cleaning machine, vacuum cleaner, water pump, water heaters</td>
</tr>
<tr>
<td>E</td>
<td>1 (0.0–1.0)</td>
<td>Low importance</td>
<td>Entertainment systems, recreation systems</td>
<td>Computer games, bowling, go-carting</td>
</tr>
</tbody>
</table>
### Result of Pilot Test

1. SAPPhIRE construct

This presented construct was thank to the four designers in the pilot test with some additional input (marked in italic format) from the two experienced designers during the real test. The PE or Physical Effect were left blank as this construct can have similar interpretation of PP or Physical Phenomenon in the context of 'ideas' or 'solutions' assessment.

<table>
<thead>
<tr>
<th>Group 1</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Action</strong></td>
<td>park the car</td>
</tr>
<tr>
<td><strong>State of change</strong></td>
<td>car is parked</td>
</tr>
<tr>
<td><strong>PP</strong></td>
<td>provided space and structure</td>
</tr>
<tr>
<td><strong>PE</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Organ</strong></td>
<td>stable ground, accessibility, payment</td>
</tr>
<tr>
<td><strong>Parts</strong></td>
<td>payment, road, parking lot, exit, entrance</td>
</tr>
<tr>
<td><strong>Input</strong></td>
<td>infrastructure to reach the parking house</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Group 2</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Action</strong></td>
<td>learn about the history</td>
</tr>
<tr>
<td><strong>State of change</strong></td>
<td>learning effect</td>
</tr>
<tr>
<td><strong>PP</strong></td>
<td>3D visual and sound input</td>
</tr>
<tr>
<td><strong>PE</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Organ</strong></td>
<td>accessibility, seats, screen, projector, 3D glasses, speakers; <em>movie sequences</em></td>
</tr>
<tr>
<td><strong>Parts</strong></td>
<td>movie</td>
</tr>
<tr>
<td><strong>Input</strong></td>
<td>electricity; <em>historical narrative</em></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Group 3</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Action</strong></td>
<td>learn more about the history</td>
</tr>
<tr>
<td><strong>State of change</strong></td>
<td>learning effect; <em>visualization, navigational, images, information structure</em></td>
</tr>
<tr>
<td><strong>PP</strong></td>
<td>content in the app, such as texts, pictures, audios</td>
</tr>
<tr>
<td><strong>PE</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Organ</strong></td>
<td>phone, app</td>
</tr>
<tr>
<td><strong>Parts</strong></td>
<td>wifi</td>
</tr>
<tr>
<td><strong>Input</strong></td>
<td>electricity; <em>database content/data</em></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Group 4</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Action</strong></td>
<td>learn and play, create engagement</td>
</tr>
<tr>
<td>State of change</td>
<td>increase knowledge</td>
</tr>
<tr>
<td>----------------------</td>
<td>-----------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>PP</td>
<td>extended reality</td>
</tr>
<tr>
<td>PE</td>
<td></td>
</tr>
<tr>
<td>Organ</td>
<td>game, players</td>
</tr>
<tr>
<td>Parts</td>
<td>headset, glasses, phones</td>
</tr>
<tr>
<td>Input</td>
<td>electricity; <em>favorite game. age</em></td>
</tr>
</tbody>
</table>

**Group 5**

<table>
<thead>
<tr>
<th>Action</th>
<th>learning about history</th>
</tr>
</thead>
<tbody>
<tr>
<td>State of change</td>
<td>gain knowledge</td>
</tr>
<tr>
<td>PP</td>
<td>content in the app, such as texts, pictures, audios</td>
</tr>
<tr>
<td>PE</td>
<td></td>
</tr>
<tr>
<td>Organ</td>
<td>app</td>
</tr>
<tr>
<td>Parts</td>
<td>phone, wifi</td>
</tr>
<tr>
<td>Input</td>
<td>electricity</td>
</tr>
</tbody>
</table>

**Group 6**

<table>
<thead>
<tr>
<th>Action</th>
<th>guide through the places</th>
</tr>
</thead>
<tbody>
<tr>
<td>State of change</td>
<td>finding places in the right order</td>
</tr>
<tr>
<td>PP</td>
<td>app content</td>
</tr>
<tr>
<td>PE</td>
<td></td>
</tr>
<tr>
<td>Organ</td>
<td>app</td>
</tr>
<tr>
<td>Parts</td>
<td>wifi</td>
</tr>
<tr>
<td>Input</td>
<td>Electricity; <em>experience of having a tour guide</em></td>
</tr>
</tbody>
</table>

**Group 7**

<table>
<thead>
<tr>
<th>Action</th>
<th>sharing experience and awareness</th>
</tr>
</thead>
<tbody>
<tr>
<td>State of change</td>
<td>promoted places</td>
</tr>
<tr>
<td>PP</td>
<td>content of the posts</td>
</tr>
<tr>
<td>PE</td>
<td></td>
</tr>
<tr>
<td>Organ</td>
<td>social media</td>
</tr>
<tr>
<td>Parts</td>
<td>phone, computer, tablet</td>
</tr>
<tr>
<td>Input</td>
<td>internet, electricity; <em>background knowledge</em></td>
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</table>

**Group 8**

82
<table>
<thead>
<tr>
<th>Action</th>
<th>sharing experience and awareness</th>
</tr>
</thead>
<tbody>
<tr>
<td>State of change</td>
<td>promoted places</td>
</tr>
<tr>
<td>PP</td>
<td>content of the posts</td>
</tr>
<tr>
<td>PE</td>
<td></td>
</tr>
<tr>
<td>Organ</td>
<td>social media</td>
</tr>
<tr>
<td>Parts</td>
<td>phone, computer, tablet</td>
</tr>
<tr>
<td>Input</td>
<td>internet, electricity; <em>favorite channel</em></td>
</tr>
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**Group 9**

<table>
<thead>
<tr>
<th>Action</th>
<th>creating a feeling and understanding</th>
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<tr>
<td>State of change</td>
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<td>PP</td>
<td>3D models</td>
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<tr>
<td>PE</td>
<td></td>
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<tr>
<td>Organ</td>
<td>Models, interaction</td>
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<tr>
<td>Parts</td>
<td>Content of simulation</td>
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<tr>
<td>Input</td>
<td>Participants experience</td>
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**Group 10**

<table>
<thead>
<tr>
<th>Action</th>
<th>engagement and knowledge</th>
</tr>
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<tbody>
<tr>
<td>State of change</td>
<td>increase the engagement and knowledge</td>
</tr>
<tr>
<td>PP</td>
<td>animated movie</td>
</tr>
<tr>
<td>PE</td>
<td></td>
</tr>
<tr>
<td>Organ</td>
<td>screen, speaker, projector</td>
</tr>
<tr>
<td>Parts</td>
<td>content of the movie</td>
</tr>
<tr>
<td>Input</td>
<td>electricity; <em>archeologist background</em></td>
</tr>
</tbody>
</table>

**Group 11**

<table>
<thead>
<tr>
<th>Action</th>
<th>create engagement</th>
</tr>
</thead>
<tbody>
<tr>
<td>State of change</td>
<td>increase engagement</td>
</tr>
<tr>
<td>PP</td>
<td>improve facility</td>
</tr>
<tr>
<td>PE</td>
<td></td>
</tr>
<tr>
<td>Organ</td>
<td>App, movie</td>
</tr>
<tr>
<td>Parts</td>
<td>phone, screen, speakers</td>
</tr>
<tr>
<td>Input</td>
<td>Electricity; group member background</td>
</tr>
</tbody>
</table>
2. Assessing Creativity of 'Ideas'

<table>
<thead>
<tr>
<th>Product sets</th>
<th>Groups and 'Ideas' name</th>
<th>Novelty rank</th>
<th>Usefulness rank</th>
<th>Creativity value = Novelty × Usefulness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Improving facility</td>
<td>Group 1: Parking lot</td>
<td>5</td>
<td>2</td>
<td>4</td>
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<tr>
<td></td>
<td>Group 2: 3D room</td>
<td>5</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Group 11: Big screen of animated film</td>
<td>5</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Learning about cultural heritage</td>
<td>Group 3: Majapahit learning app</td>
<td>5</td>
<td>2.5</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Group 9: Majapahit 3D simulation</td>
<td>4</td>
<td>2.3</td>
<td>3</td>
</tr>
<tr>
<td>Assisting the visitor to explore and discover the cultural sites</td>
<td>Group 5: Tour-guide app</td>
<td>5</td>
<td>2.5</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Group 6: Go-guide app</td>
<td>5</td>
<td>2.5</td>
<td>4</td>
</tr>
<tr>
<td>Social experience of cultural heritage</td>
<td>Group 7: Sharing experience via photo platform</td>
<td>5</td>
<td>1.7</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Group 8: Sharing experience via video platform</td>
<td>5</td>
<td>2.5</td>
<td>4</td>
</tr>
<tr>
<td>Entertaining and challenging cultural heritage experience</td>
<td>Group 4: Majapahit adventure game with AR tech</td>
<td>5</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Group 10: Animated film of Majapahit establishment</td>
<td>5</td>
<td>2</td>
<td>4</td>
</tr>
</tbody>
</table>

Note: This table shows average novelty and usefulness ranks; these are not scores; Rank (1 high, 5 low).

3. Assessing usefulness of 'ideas' based on designers intuitive notion

<table>
<thead>
<tr>
<th>Product set</th>
<th>Groups and 'Ideas' name</th>
<th>Importance of use (5 extreme importance, 1 low importance)</th>
<th>Rate of use (h/day)</th>
<th>Rate of popularity or use (no. of people) per 1000</th>
<th>Usefulness using Equation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Improving facility</td>
<td>Group 1: Parking lot</td>
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<td>3.5</td>
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<tr>
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<td>Group 2: 3D room</td>
<td>2.3</td>
<td>0.1</td>
<td>200</td>
<td>0.0004</td>
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<td></td>
<td>Group 11: Big screen of animated film</td>
<td>2</td>
<td>0.1</td>
<td>300</td>
<td>0.0005</td>
</tr>
<tr>
<td>Learning about cultural heritage</td>
<td>Group 3: Majapahit learning app</td>
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<td>1</td>
<td>200</td>
<td>0.0067</td>
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<tr>
<td>Group</td>
<td>Idea Description</td>
<td>Importance</td>
<td>Process</td>
<td>Importance Weight</td>
<td>Significance</td>
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<tr>
<td>-------</td>
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<td>-------------------</td>
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</tr>
<tr>
<td>9</td>
<td>Majapahit 3D simulation</td>
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<td>0.25</td>
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<td>Assisting the visitor to explore and discover the cultural sites</td>
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<tr>
<td>5</td>
<td>Tour-guide app</td>
<td>4</td>
<td>1.5</td>
<td>250</td>
<td>0.0125</td>
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<tr>
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<td>Go-guide app</td>
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<td>1.5</td>
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<td>0.0125</td>
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<td>Social experience of cultural heritage</td>
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<td></td>
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<tr>
<td>7</td>
<td>Sharing experience via photo platform</td>
<td>4</td>
<td>0.2</td>
<td>600</td>
<td>0.0040</td>
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<tr>
<td>8</td>
<td>Sharing experience via video platform</td>
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<td>0.1</td>
<td>400</td>
<td>0.0010</td>
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<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Majapahit adventure game with AR tech</td>
<td>2.7</td>
<td>0.2</td>
<td>100</td>
<td>0.0005</td>
</tr>
<tr>
<td>10</td>
<td>Animated film of Majapahit establishment</td>
<td>4</td>
<td>0.1</td>
<td>600</td>
<td>0.0020</td>
</tr>
</tbody>
</table>

Notes: different definition of importance of use was appeared between the pilot test and real test; in the pilot test, the designers measure the importance of use of the ideas solely based on how it could benefits the users based on the designers intuitive notion (from 1 to 5), meanwhile in the real test, the experienced designers start the importance from 0.1 to 1 because it belongs to recreational system or ideas as defined in Sarkar and Chakrabarti (2011, p.360).
## Appendix G
### Thesis Time Plan

<table>
<thead>
<tr>
<th>Jan</th>
<th>Feb</th>
<th>March</th>
<th>April</th>
<th>May</th>
<th>June</th>
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<td>3</td>
<td>4</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

| Research question/research goal, delimitation, and choice of research method |
| Contact related organization; funding application |
| Background and theory |
| Seminar and thesis specification submission |
| Preliminary study |
| Research method design and application |
| Detailed thesis proposal |
| Recruitment participants |
| Conduct research for study |
| Result and analysis |
| Discussion; thesis writing |
| Conclusion; thesis writing structure |
| First thesis draft; send to Proofreader |
| Polish writing; consult to Proofreader if necessary |
| Submit thesis draft to Reviewer and Opponent |
| Thesis defense |
| Revision |
| Submit thesis to diva portal and restructuring thesis to a paper for another academic publication |