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Implementation of Augmented Reality as Information and Promotion Media on Dieng Tourism Area

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Abstract

Information and promotion became necessary for tourists to get also improve their knowledge of tourism and their experiences about the tourist destination. Dieng tourist area had manytourist attractions and would be styled to be promoted at the world level tourism by Central Java government in Indonesia, but tourist information and promotional media not yet structured and interactive, as well as the need of media that can provide knowledge, experience for tourists with packaged in an interactive and interesting way. The purpose of this research is to produce Augmented Reality application that could visualize information of Dieng tourism objects, as an interactive, interesting information and tourism promotional media. The user would get information about every tourist attraction in Dieng through the augmented reality application that contains many contents about the sites by scanned Natural Marker that already exist in every Dieng tourist attraction sites with his smartphone.

Keywords*: Augmented reality, Tourism, Tourist experience, Promotion, Mobile application*

1. Introduction

Smartphone users by the end of 2016 reached 2.10 Billion users or 28.7% of the world's total population, about 47.4% of mobile users will soon have smartphones by the end of this year, or about 2.32 Billion smartphone users from the entire population world [1]. With so many smartphone users in the world, many mobile phone companies were concentrating in the production of smartphones to provide types and sorts of smartphones that are innovative, futuristic and sophisticated in accordance with needs and desires of the consumers, especially with the advancement of the latest technology that can be adapted into the smartphone.

Since technology that can be adapted to smartphones is becoming more advanced, this opportunity can be used as an advantage to introduce a new technology [2]. One of the new current technologies that are widely used in the development of creative and innovative media on smartphone devices is Augmented reality or AR technology. Augmented reality is one of the expressive and creative new forms of media, where Augmented reality can enrich the way humans live their daily lives and extend human experience in the real world [3]. With augmented reality technology, user will get more detailed information about something in virtual thing, but it does not replace the reality, it just added the real world with virtual thing, for the example is in the museums where artefact can be tagged with more information about its history when it is discovered [4].

As an expressive and creative media, Augmented reality is worthy of use in various multidisciplinary areas such as simulation, education, entertainment, health, and games [5]. In addition, AR is being developed as part of a smart tourism information media to provide information on destinations and attractions or events, also demonstrate its potential to become a new tourism service [6]. A research conducted by Marimon at 2010 in a journal entitled Mobi AR: Tourist Experience Through Mobile Augmented reality states, tourists tend to see mobile apps as well as gadgets that have information about locations, activities and historic places [7]. Another research conducted by tahyudin, use of Augmented Reality system was positively affected by the feeling of pleasure and excitement for the users [8].

Tourism field continues to grow rapidly and it is being a strategic industry to increase government revenue which it has great potential [9], as well as the number of tourists who seek

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the information about the location of the tour that will be visited. Augmented reality technology can be used as a medium conveyance of information about the elements of tourist locations With AR technology, it helps tourist attractions that have been visited begin more familiar when other tourists went to these attractions [2]. In addition to the use of Augmented reality as a medium of information, Augmented reality can also be used as a media campaign with an innovative, creative and interactive form to make users of applications entertained and accepted smartphone users as well [10]. The form of interactive promotional media and Augmented reality advertising, allows users to properly engage with the advertisement, so everything becomes private and directly creates connections with the users [11].

Therefore, an idea arises to implement an AR application as information and promotion media on tourism, hope that it can be used as a tool for tourists who want to travel, to explore and add deeper knowledge about the tourist information sites that have visited, as well as promoting tourism events especially in the tourist area of Dieng. The purpose of this research is a practical implication of the development, testing, and evaluation of augmented reality technology combined with a mobile smartphone that implemented on tourism aspect. With a goal to support users that require more information about the tourism destination that is less in reality and also to promote Dieng Tourist sites.

2. Research Method

The research method used in this research is Research and Development approach (R & D). Research and Development method is a research method used to produce a specific product and tests the effectiveness or feasibility of the product [12]. Research and Development method in this research aims to develop an application of Augmented reality as media of information and promotion. This research method is done with several stages: potential and problem, literature study, product development, expert validation, product revision, product trial, product revision, user response, product revision and final product. Flow diagram of the research process with research and development method can be seen in Figure 1.

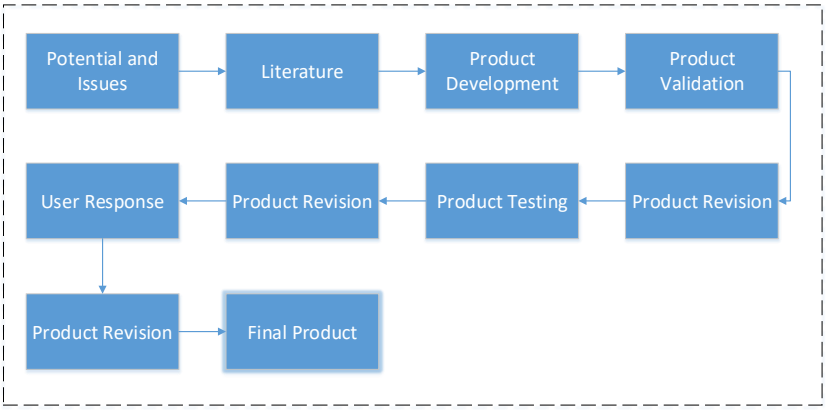

Figure 1. Steps of Research Methods

In the product development stage, it uses the Waterfall development model. Waterfall or so-called Linear Sequential Model is a model developed in the development of a software or application. In the Waterfall model, the development stage is systematically from one stage to another stage such as the waterfall model.

This development model proposes an approach to systematic and sequential software development, from needs to analysis, design, coding, testing, and maintenance. This development model is linear from the early stages of software development, from planning stage until the final stage of system development; it is the maintenance stage [13]. Figure 2 is a step diagram of the application development process or software with the Waterfall model.

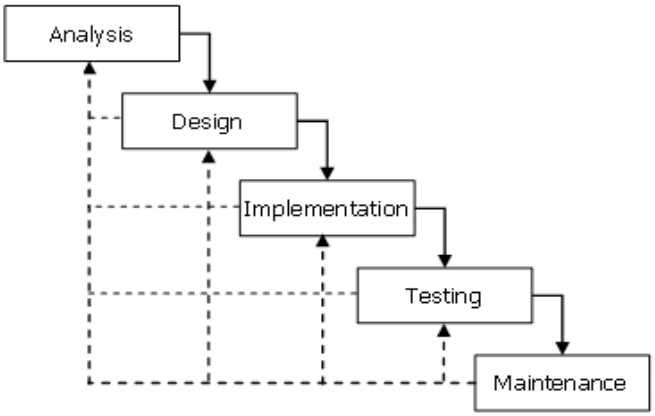

Figure 2. Steps of the Application Development Dieng AR

3. Results

Results in this research divided into two parts, result of software development and the result of software testing.

3.1. Results of Software Development

After passing the stage of analysis, design, implementation of the code, testing, and maintenance of Waterfall development cycles, then got a fixed application called Dieng AR. Dieng AR runs on Android OS smartphone with gingerbread for minimum OS requirements. The app can you get at Google Play Store for free. When you first open Dieng AR application, it will appear splash screen and loading screen shown in Figure 3.

In Augmented Reality technology application, especially the most important Marker-based Augmented Reality is the marker which used as a virtual object augmentation reference. Dieng AR is using the natural Marker located in the tourist area of Dieng, for that should visit Dieng, or in the application, there is a Marker download menu like Figure 4 which provides a link to download images or markers that used. If the user can not find the images or markers that application used in the Dieng tours sites, theuser can download the marker from the app. The natural marker that used had chosen by the researcher from the Dieng tourist sites and provide it to be a marker for the app.

Figure 3. Loading Dieng AR Screen

Figure 4. Markers used by Dieng AR

Markers when it scanned with Dieng AR application, it will appear information about the tourist attraction or tourist event automatically above the markers as shown in Figure 5, on this information display is also an available button to play Video and view other information. Display of information language that appears is according to the language selection.

Figure 5. Information appears during augmentation

Dieng AR application uses a variety of markers which it had taken from the original image in Dieng tourist attraction. The process of scanning Marker with Dieng AR application is figured out it Figure 6 which is done outdoors.

Figure 6. Scanning a natural Marker in Dieng

Figure 7. Dieng AR display when it scanning outdoor

Similar to the usual Marker scans, Dieng AR applications was scanning well, and detected marker as well too, with the display of information content tailored to the Marker that had detected on each tourist sites, Figure 7.

3.2. Testing

Software quality can be assessed through specific method measures and methods, as well as through software testing. One of the software quality measures is ISO 25010, created by the International Organization for Standardization (ISO) and the International Electrotechnical Commission (IEC). ISO 25010 replaces the previous standard of ISO 9126 [14], altered some classifications while still maintaining generalized hierarchical parsing [15]. ISO 25010 establishes eight characteristics of functional suitability, reliability, performance efficiency, usability, maintainability, security, compatibility, and portability which subdivided into a series of sub-characteristics [14].

This research use four characteristics that exist in ISO 25010, there are functional suitability, portability, performance efficiency and usability. The selection of these 4 characteristics is in accordance with the test of the device consisting of various aspects of test presented by Assaf Ben David, there are functional testing, compatibility testing (definition of compatibility that David said has a common understanding aspects of Portability ISO 25010), Usability testing, performance testing, security testing, operability testing [16], as well as Segue Technologies Quality Control team, which they have revealed that the category in performing mobile applications consists of functional tests, compatibility tests (meaning compatibility presented by Segeu Tech has similar understanding with aspects of Portability ISO 25010), performance tests and Usability tests [17].

1) Functionality Suitability testing

Tests on aspects of Functionality Suitability is using Blackbox test and validation by experts. In the Blackbox test where test results are obtained with 34 test scenarios, yielding 100% of successful or valid test scenarios, all scenarios correspond to expected results. Expert validation in knowing the validity of this application using a questionnaire. Questionnaires were given to the experts in the field of software engineering and stakeholders who knew about the tourist area of Dieng selected to test the application. Table 1 shows the percentage of the application validation by media and material experts.

Table 1. Validation Result

No.	Validation Experts	percentage	Criteria
1.	Media Experts	90,27%	very well
2.	Content Experts	82,95%	very well
	Average	86,61%	very well

The average validation results score is 86.61%, which it means the media meet the criteria very well / deserve to be used as an information and promotion media also qualify for the next stage.

2) Portability testing

There are 3 sub-characteristics according to ISO 25010 on portability testing: adaptability, installability, and replaceability testing. Portability testing on Dieng AR application divided into 3 stages,

1. Installs and runs on different devices with different OS.
2. Installs and runs on various devices with different screen sizes.
3. Install and run on various devices and then updated with new versions of the application

Testing portability number 1 and 2 wereusing Cloud Testing Google Firebase Test Labs consist of 35 smartphone devices with various versions of Android systems, smartphone brands, screen sizes and other specifications. While it is testing to install, run and update on various physical devices or directly, with 5 different smartphone devices.

a. Based on the results of portability testing by installing and running smartphone devices with different versions of OS from Cloud Testing Google Firebase Test Labs obtained 100% percentage of success that shown in Figure 8.

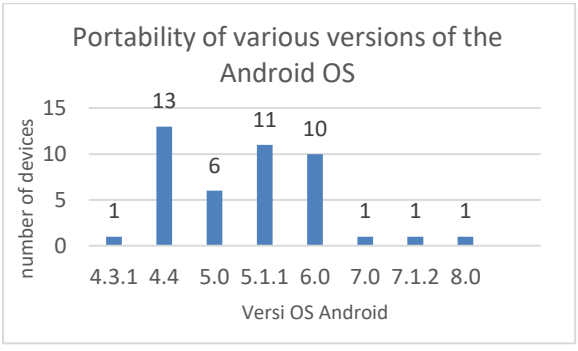

Figure 8. Dieng AR portability test chart on various Android OS

b. Based on the results of portability testing by installing and running smartphone devices on various screen sizes from Cloud Testing Google Firebase Test Labs obtained 100% percentage of success that shown in Figure 9.

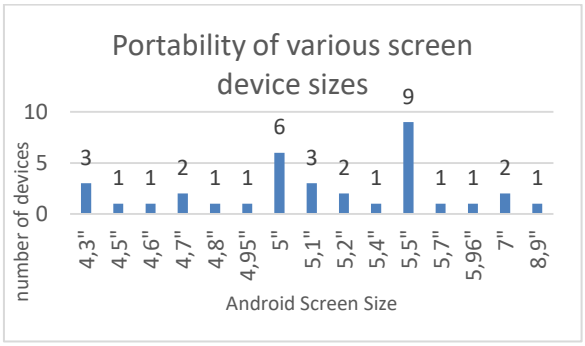

Figure 9. Dieng AR portability test charts on various screen device sizes

c. Portability testing results by installing, running and updating smartphone devices of various brands, OS version and screen size of 5 devices obtained 100% percentage of success that shown in Table 2.

Table 2. Portability test on 5 devices

No.	Smartphone	OS	Screen Size	Install	Run	Update
1.	Samsung J2	5.1.1	4,7”	√	√	√
2.	Oppo A37f	5.1.1	5”	√	√	√
3.	Lenovo A6000	4.4.4	5”	√	√	√
4.	Xiaomi Redmi 3S	6.0.1	5”	√	√	√
5.	Sony Xperia ZR	5.1.1	4,5”	√	√	√

Based on the overall portability test results, it can be concluded that Dieng AR application can be installed, ran, updated and un-installed on difference device environments.

3) Performance Efficiency testing

The Performance Efficiency testing is tested 2 sub-characteristics according to ISO 25010, i.e. time behavior and resource usage. Performance testing divided into 2 stages, there are:

1. Calculates application launch time when first started.
2. Calculates smartphone resource usage when the app is running.

Performance test number 1 and 2 tested manually using 5 smartphone devices with different specifications. Then with stopwatch and system monitor app helps, calculates the application performance starting from launch time and the resource usage. Here are the results of both performance experiments performed. From the performance test in the subcategory of time behavior, the average time of launch time required for applications on the 5 different devices is 1817 millisecond shown in Figure 10.

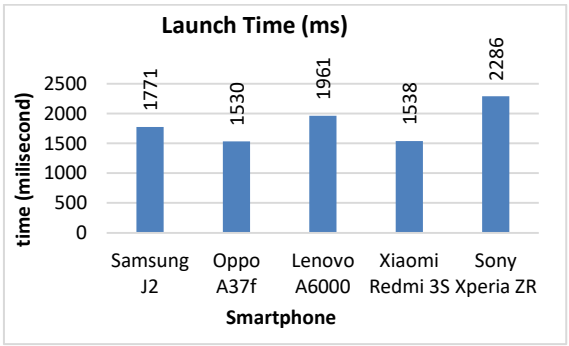

Figure 10. Dieng AR performance launch test graphs from various devices

From the performance efficiency test in the usage resource sub-category, the average use of CPU and application memory on 5 different devices when running Dieng AR application is 0,22% CPU usage and 177,8 MB memory usage shown in Figures 11 and 12.

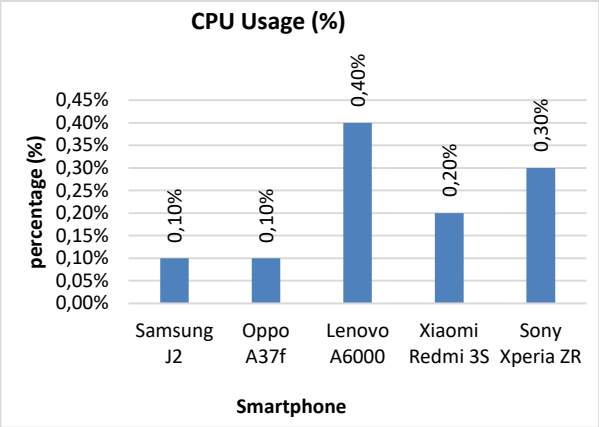

Figure 11. Dieng AR CPU usage performance graph of various devices

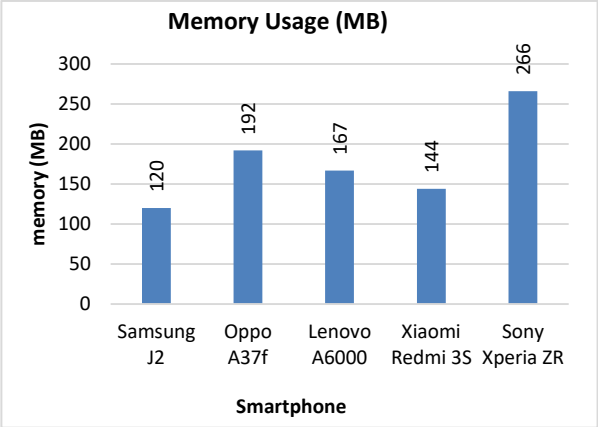

Figure 12. Performance test graph of Dieng AR Memory usage from various devices

Application performance test results show launch time with an average launch time is 1817 millisecond with the fastest launch time is 1530 millisecond and slowest launch time is 2286 millisecond and resource use with an average of 0,22% use of CPU and 177,8 MB of memory usage, with 0,1% lowest CPU usage resource and 0,4% at the most CPU usage, while the lowest memory usage is 120 MB and 269 MB is higher when the tested devices run Dieng AR application.

4) Usability testing

Usability testing in this research using user responses implemented in Dieng tourist areas, by involving tourists and people, with 50 users of all. User response in this research using usability testing, where to know the user response Dieng AR application as a media of information and tourism promotion in the Dieng tourist sites.

The results of user responses carried out with calculations according to the guidelines of the SUS (System Usability Scale) processing [18]. The calculation of SUS scores results gets the final average score of 79.6, where the score goes in the score range >70 which means, Dieng AR application qualify the criteria acceptable or feasible to use by SUS scoring [19], and it's mean that this application has been in accordance with the purpose of research and development to produce an effective and feasible application [20].

4. Conclusion

The mobile AR that had proposed, allow the users or tourists to obtain information about the tourist sites and tourists attraction on one smartphone application by scanning natural marker in each tourist sites. Use of augmented reality technology on a mobile smartphone for tourism aspect is a great potential opportunity to improve touristknowledge of tourism and their experiences about the tourist destination, as it does not replace anything in reality, but it improves what is already there with more important and interesting contents that we cannot get directly. It also makes tourist curious about what itsdetailed information in each destination.

The development of an Augmented reality application for tourist information and promotion media has result of several testing to provide feasibility of the app based on ISO 25010 showed that the mobile AR for tourism was generally satisfied with the functional, compatibility, performance aspect, also on usability aspect has a SUS score that qualifies the criteria for an acceptable app for the public to use. ISO 25010 can be used for app developer and researcher to be app testing reference for testing, so an acceptable app for public and

research can be obtained. For futurework, researchers can develop an application that uses GPS for Markerless tracking to provide easiness of access AR information in many places in the tourist destination and also combine AR with VR technology for abetter experience.

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