Testing the Budhara Digital Book Application (Borobudur Dalam Cerita)

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Abstract - Borobudur Temple is one of the icons of Indonesian tourism in the world. Unfortunately, tourists, domestic and foreign, do not have knowledge of the importance of the existence of Borobudur Temple as a cultural heritage. Evidence of the lack of knowledge of domestic tourists about the conservation of Borobudur Temple is reflected in the vandalism of thousands of people who left stains on the Borobudur stone. This has the potential to damage the rock layers of the temple. Foreign tourists themselves are also seen as lacking comprehensive knowledge about Borobudur Temple. They know a lot about the history of Borobudur, but do not understand the history of the villages surrounding the supporters of Borobudur Temple. The history of the villages around Borobudur is an important element in supporting Borobudur as a cultural heritage. In addition, efforts are needed to maintain tourist interest in visiting Borobudur Temple and the surrounding villages during the limited number of visitors. For this reason, a way is needed to educate the general public about the history and conservation efforts of the Borobudur Temple and the surrounding villages which have historical and geographical links. Based on these problems, the researchers developed a digital book called Buddhara (Borobudur Dalam Cerita) and has been testing using questionnaire.

Keywords – Borobudur Temple, Application, Digital book, Questionnaire

1. INTRODUCTION

Borobudur Temple is the largest temple or shrine in the world for Buddhists and one of the largest Buddhist monuments in the world. This monument consists of six square terraces on which there are three circular courtyards, the walls are decorated with 2,672 relief panels and originally there were 504 Buddha statues. However, tourists, both domestic and foreign, do not have knowledge of the importance of the existence of Borobudur Temple as a cultural heritage [1], [2].

Evidence of the lack of knowledge of domestic tourists about the conservation of Borobudur Temple is reflected in the vandalism of thousands of people who left stains on the

Borobudur stone [3]–[5]. This has the potential to damage the rock layers of the temple. Foreign tourists themselves are also seen as lacking comprehensive knowledge about Borobudur Temple. They know a lot about the history of Borobudur, but do not understand the history of the Borobudur cultural heritage area. The history of the Borobudur cultural heritage area is an important element in supporting the existence of Borobudur Temple [6]. In addition, efforts are needed to maintain tourist interest in visiting Borobudur Temple and cultural heritage areas during the limited number of visitors. For this reason, a way is needed to educate the general public about the history and conservation efforts of the Borobudur Temple and cultural heritage areas that have historical and geographical links.

Based on these problems, this research proposal aims to develop an Educational Model for the Preservation of the Borobudur Cultural Heritage Area using Multimodality-Based Interactive Animated Bilingual Storytelling. This conservation education model will combine digital media in the form of virtual reality (VR), augmented reality (AR), and interactive digital books with educational content and conservation of the Borobudur cultural heritage area and delivered in bilingual texts that can be understood by domestic and foreign tourists. The urgency of this research is that these media are not yet available in Borobudur Temple (on site) and the surrounding cultural heritage area (off site). This is also a problem raised by partners, such as:

1. There is no multimodality-based bilingual preservation educational digital media in Borobudur Temple and cultural heritage areas. This has an impact on no self-explanatory facilities for tourists, so tourists have to rely on tour guides/official officers to be able to obtain information.
2. There is no media that provides education about the preservation of Borobudur Temple. Borobudur Temple is only treated as a tourist attraction, so there is no effort to maintain its preservation (conservation).
3. There is no media capable of providing new experiences outside of visiting temple sites during the limited number of visitors. Visitors can feel bored and uninterested when visiting Borbodur Temple is restricted.

Media that will be installed on site and off site, in the form of VR and its goggles, AR and media cards, and digital books in the form of tablets packaged in standing tables or standalone gadgets. The uniqueness of the development of this educational conservation model is the installation of multimodality-based digital media (animation, virtual reality, 3D holograms, sound, and 2D images) that can be installed at the tide points of Borobudur Temple, surrounding cultural heritage areas, tourist tour vehicles. Borobudur Temple and inns in the cultural heritage area.

The use of multimodality is also expected to attract tourists, domestic and foreign, from all age groups to examine educational content for the preservation of the Borobudur cultural heritage area which contains the history of the Borobudur Temple and the cultural heritage area, maintenance activities for the Borobudur Temple, and an explanation of the parts of the temple and interesting places in the cultural heritage area of Borobudur. The digital media developed in this research is media that has not yet received Intellectual Property Rights (IPR) because it is still in the development stage.

2. RESEARCH METHOD

This study uses an exploratory method with a historical and cultural approach. The exploratory method aims to explore broadly about the causes or things that influence the occurrence of something, is open, looking for elements, characteristics and characteristics of the object of research. The historical approach aims to systematically and objectively reconstruct

past phenomena by collecting, evaluating, verifying and synthesizing evidence to establish facts in order to draw accurate conclusions. And a cultural approach is carried out on an object in the form of a cultural element or symptom by using methodological tools included in cultural science. The focus of this research is related to religious teachings, moral messages, culture, and mathematical patterns found in Borobudur Temple. Geographically, Borobudur Temple is located on Badrawati Street, Borobudur District, Magelang Regency, Central Java Province, Indonesia.

2.1 Borobudur Temple

Philosophically, the understanding of Buddhist teachings as a guide to moral messages can be found in sculptures about stories that contain stories of Karmavibhangga, Lalitavistara, Avadana, Jataka, and Gandavyuha in all the reliefs of Borobudur Temple. If you trace the story on the relief as a whole in a clockwise direction, you will get a unified story that contains messages about human life. Implicitly the story describes human life, if you do good you will get good rewards in the hereafter, and vice versa, bad deeds will get bad rewards too. Likewise, the reliefs on the walls of Kamadhatu, explain the law of karma from human actions committed during his lifetime.

In terms of culture, the existence of the Borobudur Temple implies that ethnomathematics had developed at that time, where mathematical concepts were used to build the Borobudur Temple and became a culture in the form of activities in human life. In addition, there is a message that Borobudur Temple is a form of classical Javanese culture in the form of a temple structure. Even the world has designated Borobudur Temple as a world heritage (World Cultural Heritage) in the cultural category in 1990 [3], [7].

Borobudur is a temple for Buddhists located in Borobudur, Magelang Regency, Central Java Province, Indonesia. This temple is located 100 km to the southwest of Semarang City, 86 km to the west of Surakarta City, and 40 km to the northwest of Yogyakarta City. This temple is shaped like a stupa which was erected by Mahayana Buddhists around the 8th century AD during the reign of the Syailendra dynasty.

Archaeological findings state that in 700-900 AD, Central Java was the center of Hindu and Buddhist kingdoms. This is in accordance with the agreement of experts who state that the construction of Borobudur Temple took place around 700-900 AD. Therefore, this temple is synonymous with Hindu-Buddhist teachings. Temples are ancient buildings made of stone as a place of worship, storing the ashes of Hindu-Buddhist kings and priests in ancient times. In modern times, the notion of a temple refers to a place of worship relics of Hindu-Buddhist civilization and used to function as a place to honor Buddha. The Borobudur Temple building consists of six square platforms and on top there are three circular platforms which are decorated with 2,672 relief panels and 504 Buddha statues. Borobudur Temple not only has an area of physical structure, but also stores Buddhist teachings which are conveyed through symbols on statues, reliefs and stupas. The structure of the Borobudur Temple consists of three parts, namely: the head, body and legs. These parts of the Borobudur Temple have different meanings and are implicitly related based on Buddhist concepts, namely the phases of soul development and episodes of the life of the Buddha.

The foot of the temple is called Kamadhatu, as the base of the temple building and contains 160 panels. This section describes the first realm of the three layers of human spiritual awareness according to a Buddhist concept called Kamadhatu or the realm of lust, where animal character dominates human personality. In this section there is a relief that contains the story of Karmavibhangga, depicting the journey of human life in the world, where humans are still controlled by lust and mental preparation that must be achieved before reaching the final goal, namely being free from worldly bonds.

The body of the temple is called Rupadhatu, containing 1,300 panels which imply an "intermediate realm", namely the stage where humans can overcome their desires and noble tendencies emerge, but they are still affected by unique human characteristics. In the body of the temple there are four aisles [2], [4], [5], [8]–[11]. In the first aisle of the temple wall contains 740 panels, telling stories:

1. Lalitavistara, a depiction of the life story of Sidharta Gautama as the founder of Buddhism, from his birth to reaching the place where the Buddha meditated and received enlightenment called Boddhi.
2. Jataka, describes the Buddha before birth as Siddhartha Gautama, and
3. Avadana, describes saints. In the second aisle of the temple wall contains 228 panels, telling Sudhana who wants to know about boddhi.

In the third aisle of the temple wall contains 176 panels, depicting the story of Gandavyuha, which is about perseverance and tireless efforts to achieve the final goal. In the fourth aisle the walls of the temple contain 156 panels, also telling the story of Gandavyuha. The head of the temple is called Arupadhatu (upper realm), is the realm of the gods or the highest level which symbolizes emptiness, peace and tranquility, the spiritual realm without lust and desire. This level describes a person in his life's journey if doing good step by step will reach the peak, namely boddhi or the highest level [8], [9], [12].
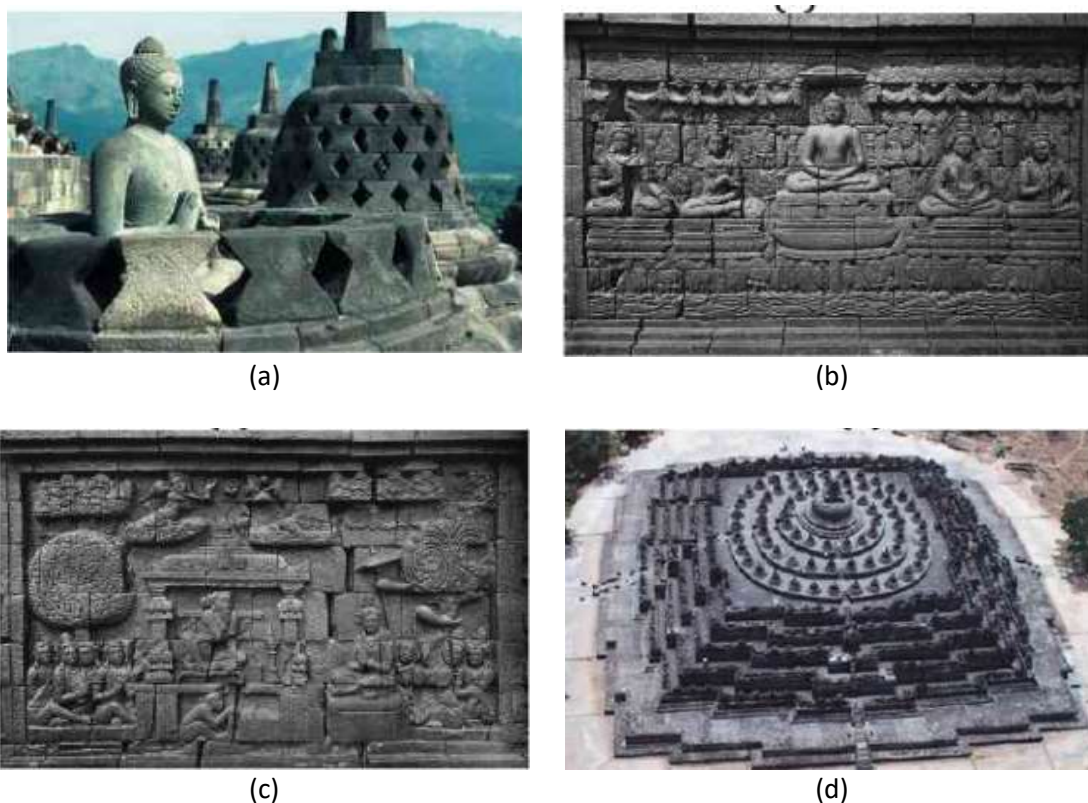

Figure 1. (a) Budha's Statue, (b) Relief budha, (c) Relief Sudhana, (d) Aerial Photography of Borobudur Temple [3], [7], [12], [13]

2.2. Analysis Method

The analytical method is used to describe the virtualization system for the Borobudur Temple building into components to identify and evaluate the problems. The system being analyzed is a system that contains information about everything related to the exploration of building design in the form of multimedia, in the form of information on text, images, sound,

animation, 3D graphics that are applied using a computer. The system being analyzed is the workings of the Budhara Application, which is an application that stands alone using a computer as the medium. This analysis stage is the most important stage in the program being designed, because this stage determines the next stages, if an error occurs at this stage it will affect the next stage which will result in continuous errors. Therefore we need an appropriate method as a guide in developing the system being built.

2.3. Digital Book

A digital book itself is an electronic book that has elements of written text, images and graphics (motion graphics). A digital book must have five features which are reflected in the following Figure 2.

Figure 2. Relationships Between Digital Book Features

The navigation feature is a feature for carrying out the functions of the buttons in digital books. The manipulation feature is the final effect or result that appears when the user accesses the digital book. Control feature (controlling) is a feature to play, pause, and stop graphic text. The search function is a search feature via hyperlinks or internet search. The dialogue feature is a communication feature between participants and administrators. These five features are interrelated features, but the features that must be present in a digital book are navigation, control, and search features. In addition to the completeness of features, another thing that can improve the quality of digital books is cross-modal coherence. Cross-modal coherence is the unity of images, written text, meta-information, implied information, and the goals to be achieved by the cross-modal text.

2.3. Input Analysis

Input is a form of input in the form of data needed by the software to obtain the desired results and goals.

2.4. Hardware Requirements Analysis

Hardware (Hardware) is used to process data that can process data automatically in the form of text, audio, images, and animation. The content that will be displayed is this application is 3D content, so a computer device that has the ability to process graphics is required. The required hardware specifications are divided into two parts, namely from the application development side and from the user side. The applications needed for application development include:

1) The input devices are keyboard and mouse
2) Monitor device with minimum specifications of 800 x 600, and speakers
3) A graphics card that supports DirectX 11, with at least 512MB of memory
4) Processor at least dual core and has a minimum speed of 2 GHz
5) RAM memory of at least 8 GB
6) A hard drive that has at least 20 GB of free space

Applications needed by users of the Borobudur Temple visualization multimedia application include:

1) The input devices are keyboard and mouse
2) The output device is a monitor with a minimum resolution of 800 x 600, and speakers
3) A graphics card that supports DirectX 11, with at least 256MB of memory
4) Processor has a minimum speed of 1.8 Ghz
5) RAM memory of at least 3 GB
6) A hard drive that has at least 100MB of free space

2.5. Software Requirements

Apart from hardware, software is also needed in developing applications and in running applications. The same goes for hardware requirements analysis. In software analysis, this is also divided into two sides, namely from the side of application development and application users. The software requirements for application development are as follows:

- Operating system, the operating system for application development is Windows 7.
- 3DsMax, an application used for modeling all temple objects and their supporting objects.
- V-ray, is an additional application for rendering in which there are facilities for texturing and lighting, so that the created object looks more real.
- Unity3D, this application is used to build a virtual home, 3D objects are entered into unity3D to then build the Borobudur Temple Visualization Multimedia application. Unity3D also serves to provide additional effects and controls on the engine. This software is the main software for building a stand alone application.
- Adobe Photoshop, Adobe Photoshop is used to edit, create images and modify textures used in 3DsMax and Unity3D.
- Adobe Sound booth, this software is used to edit audio which will later be used in a multimedia visualization application for the Borobudur Temple.
- FruityLoop, this application is used for audio music arrangements that have been made previously with Adobe Sound Booth. While the software required by the user to run the Borobudur Temple Visualization multimedia application is Windows XP, Windows Vista, Windows 7, Mac OS.

3. RESULTS AND DISCUSSION

The results and discussion explain the implementation of the software which includes the limitations of the implementation and implementation of the software in the form of the

main menu. Interface design, program testing, and menu testing, program performance analysis, and system strengths and weaknesses.

3.1 Implementation Limitations

The Borobudur Temple Virtualization application was designed using Unity3d software version 2.5 and version 3.3. This system is designed to build a building visualization application that can be accessed directly. In its visualization, the existing properties have detailed limitations to improve application performance. The limitations of these details include the texture that is made is real texture, namely the texturing method using images of real objects, which are processed in such a way using Adobe Photoshop software. So that the color depth, saturation, and color balance, as well as the shape of the glass reflection are obtained from the actual situation.

3.2. Manufacturing Stage

1. Data analysis.

   Collect various data about the built scale plans, take photos of the real state of the objects to be built to continue making 3D models.

2. Design.

   Design and create a HIPO chart as a medium for system design. Make the basics of the interface (interface), using Adobe Photoshop software.

3. Modelling.

   The main building of Borobudur Temple and its properties are modeled into 3D objects.

4. Creating and texturing.

   Texture making uses the real texture method, namely taking real images, which are then processed in such a way using Adobe Photoshop software equipped with the Nik Color Pro software plugin version 3.0, then designed in such a way as to get real textures that can be repeated based on the x, y, z axes.

5. Musical arrangement.

   Is the backsound of the Virtual Borobudur Temple application. This was done using Adobe Soundbooth software, and Cool Edit Pro, as well as Fruity Loop for the music arrangement section.

6. Coding.

   With Unity3d software, the Borobudur Temple Virtual engine was built and render optimization managed to then proceed with building applications based on Windows and Mac OS.

7. Testing.

   Conduct testing and analyzing software in a simple way, such as testing it on several users and then conducting a questionnaire to obtain a more accurate analysis result.

3.3. Background Making Stage

Then the next stage is making music as the backsound of the application at the temple virtual map level. For this stage, sound editing uses software, namely Adobe Soundbooth, Cool Edit Pro, and Fruity Loop. The next stage is the coding and rendering optimization stage of the application. For this stage using Unity Pro software version 3.3. In the coding stage, all models that have been textured are entered into Unity, then the scale is multiplied by 25 and given a collider.

3.4. Interface Design

Interface design aims to make it easy to implement the software to be built. This interface also functions as a means of interaction between humans and computers. The interface on the Temple Visualization application is an illustration of the interface on the application page. The main page display is the initial display when the user first runs the application. The main page contains the main menus that can be accessed by the user.

3.5. Software Testing Analysis

In the analysis stage of consumer satisfaction, a questionnaire was administered to 20 testers. The questionnaire was carried out by including several aspects of customer satisfaction proposed by Wilkie (1994), including: Expectation, Performance, Comparison, Confirmation / disconfirmation, Discrepancy. The scale method used is the Likert method [14], [15]. The scale used has four choices, namely: SS (Strongly Agree), S (Agree), KS (Less Agree), TS (Disagree). For the SS scale (Strongly Agree) was given a score of 4, for the S scale (Agree) was given a score of 3, for the KS scale (Disagree) was given a score of 2, and for the TS scale (Disagree) was given a score of 1. The distribution of consumer satisfaction scale items can be seen in Table 1.

Table 1. Scale of Consumer Satisfaction Before Trial

No.	Appearance	Scale Item Number	
1	Expectation	I feel that this Buddhara Application can give an overview of Borobudur Temple in general.	8
2	Performance	I can use this Budhara Application easily. I feel this Budhara Application has an attractive interface. I feel that this Buddhara Application can be used as a medium of information about the Borobudur temple. I feel the Budhara Application is easier to find information. So far, I am satisfied with the Budhara Application.	1, 2, 6, 7, 10
3	Comparison	So far, I am satisfied with the Budhara Application.	4
4	Confirmation / Disconfirmation	I want to use the Buddhara Application as a medium to find brief information about the Borobudur temple. I advise potential tourists to use the Budhara Application before coming to the location.	5
5	Discrepancy	I feel that this Budhara is suitable for promotional media for the Borobudur temple for potential tourists.	3

Judging from the results of the analysis in Table 1 and Table 2, the mean total analysis results are 3,290. For a total mean of 3,290 > 2.0, it can be concluded that the Bbudhara Application software to 20 respondents is acceptable, useful and can be implemented as one of the information media for Borobudur temple for potential tourists.

Table 2. Questionnaire Results

No.	Name	Gender	Age	Question									
				1	2	3	4	5	6	7	8	9	10
1	Nadifa Ayu M.	F	20	4	4	4	4	4	3	2	3	3	3
2	Hendra Putra A.	M	18	3	4	3	3	4	3	3	4	3	3
3	Fandy Aldi W.	M	22	3	3	4	3	3	4	3	3	3	4
4	Ayu Widi	F	20	4	4	4	4	4	4	4	3	3	3
5	Maryam Vidia L	F	23	4	4	3	3	4	3	4	3	3	3
6	Gemintang K.H	M	18	3	4	3	4	4	3	3	3	3	3
7	Wahyu Noto S.	M	22	4	4	3	3	3	3	3	3	3	3
8	Ayu cahya N	F	20	3	4	4	4	4	4	4	4	4	4
9	Dea Ayu	F	21	4	4	3	4	3	3	3	3	3	3
10	Fauzan Alkatiri	M	19	2	4	3	4	3	3	3	4	3	3

11	Faustina Celyin	F	24	2	3	3	3	3	3	3	3	3	3
12	Jihan Nayana	F	24	3	2	3	2	3	3	3	3	3	3
13	M. Khoiry	M	23	2	3	4	2	3	3	3	3	3	2
14	Imam Bachtiar	M	23	4	4	3	3	3	4	3	3	3	4
15	Dwi Widowati	F	20	3	3	3	3	3	3	3	3	3	2
16	Setyani Wulandari	F	22	2	3	4	4	3	3	3	3	3	3
17	Afrahana K	F	22	3	3	3	4	4	3	3	3	3	3
18	Sanditya Wibowo	M	23	4	3	3	3	3	3	3	4	3	3
19	Samuel Zirana	M	23	4	3	3	3	3	3	3	3	3	4
20	Wulan Arum S	F	18	4	4	4	4	4	4	4	4	4	4

After obtaining the questionnaire data, the data is processed to obtain the mean analysis results. Data analysis results can be seen in Table 3.

Table 3. Statistics Questionnaire Results

No.	Question	Maximum Value	Minimum Value	Mean
1	Question 1	3.00	4.00	3.350
2	Question 2	2.00	4.00	3.150
3	Question 3	2.00	4.00	3.350
4	Question 4	2.00	4.00	3.200
5	Question 5	3.00	4.00	3.400
6	Question 6	3.00	4.00	3.500
7	Question 7	2.00	4.00	3.150
8	Question 8	2.00	4.00	3.400
9	Question 9	2.00	4.00	3.200
10	Question 10	3.00	4.00	3.200

After conducting an analysis using a questionnaire and a Likert scale, it is known that there are weaknesses and shortcomings in the application. After simple testing of the system, the advantages and disadvantages of the system can be identified as follows:

a. System advantages
1) The display used is three-dimensional so that it looks more real and the user feels as if he is visiting Borobudur Temple.
2) The application that was built, is equipped with a summary of historical information from the story of the carvings of the temple so that users can find out the true story of the carvings of the Borobudur temple.
3) The application that is built is equipped with an installer, so it will reduce the capacity consumption of the computer's hard drive.
4) The Buddhara application is built on the .exe and .dmg extensions, so that the Borobudur temple visualization application can be directly run using Windows or Mac OS operating systems.

b. System flaws
1) The environment, flora and fauna vegetation in the Buddhara application is still very minimal.
2) There is no animation on the welcome screen, so it seems less attractive on the initial display.
3) There is no indication of cardinal directions or maps when the application is running, so that it can make application users confused.
4) Lack of material management so that the Budhara application is still heavy enough to run on a computer with low specifications.

4. CONCLUSION

The precision in designing cross-modal coherence is complicated by the bilingualism aspect of this digital book. With the aspect of bilingualism, this digital book in Indonesian and English targets two readers, namely local (national) readers and foreign (international) readers. These two groups of target readers have opposite characteristics. This characteristic is called travel behavior or different travel behavior between domestic and international tourists. Domestic tourists prefer things related to shopping and tourism that are materialistic in nature, while international tourists (especially from Europe, Australia, America and Japan) prefer things that are exotic, such as natural or cultural tourism. This of course affects the selection of images or visuals in a tourism information medium. Based on the results of research, analysis, system design, and programming to completion, several conclusions can be drawn, including the following:

a. The Budhara application in the form of building map content for the Borobudur Temple has been successfully built and has succeeded in incorporating 3D objects into the application and can be explored directly through the application.
b. The Budhara application can provide an overview to the user regarding the shape, condition, and can find out information about the reliefs of the Borobudur Temple.
c. From the results of the analysis obtained from 20 respondents, the total mean value was 3,290. For a total mean of 3,290 > 2.0, it can be concluded that the Buddhara Application can be applied as one of the information media for Borobudur Temple.

Based on the shortcomings and limitations that exist in the Buddhara Application, it is recommended:

a. In the next development it is suggested that there are more interacting objects, for example there are flying birds, there is a 3rd person so that it seems more real.
b. In giving the texture of the carving, you can then insert the carvings of the temple as a whole so that they look as real as their original state.
c. There needs to be a GUI for the Borobudur temple plan so that users know the actual position after exploring the temple.
d. There are no animations when changing levels, so it seems less interesting. And it is hoped that for its development there will be additional animations at each level.
e. It is necessary to add material about the history of the temples and stories about the refiefs on the walls of the temple apart from the history that has been presented in this game.

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