3D Perspective Interpretation on the Reliefs of the Borobudur Temple

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Abstract. This study is motivated by the anxiety of the proposing researchers about the methods and models for telling the reliefs of the Borobudur temple which until now have not been explained in a straightforward manner by previous literature. Currently, the available discourse is only visual language coding and interpretation of the story of the reliefs of the Borobudur temple. This study proposal aims to interpret and find a method of telling the reliefs of the Borobudur temple through a three-dimensional environmental perspective and story-building elements. The research methodology used practice-led research. Assessment of visual data (relief photos) underlies the stages of identification, description, reference, adaptation, sublation, and inspiration. This study found a method in interpreting 2D concepts into a 3D storytelling perspective using box in 3D projection. Actually, there are some methods of interpretation, however this article is focused on one of the interpretations through the 3D projection method. In general, it can be concluded that the 3D projection method can be used to interpret 2D images on the reliefs of the Borobudur temple to a three-dimensional environmental perspective.

Keywords: 3D Perspective Interpretation, Storytelling of Borobudur Reliefs, Three-Dimensional Environment, 3D Projection.

1   Introduction

Borobudur Temple is a masterpiece of art that was built around 780 – 830 AD by the Sailendra dynasty [1] and is still standing strong and majestic today. Borobudur Temple is considered as an ancient architecture that has eternal value and the function of messages in it is timeless [2]. This temple has 1212 decorative relief panels and 1460 narrative relief panels [3]. These reliefs are visualizations of Buddhist scriptures. In other words, the reliefs and architecture of the Borobudur temple are the development of visual perception based on the interpretation of Buddhist texts [4].

King Samaratungga as the ruler of the Sailendra dynasty who at that time completed the construction of the Borobudur temple, succeeded in depicting Buddhist teachings in visual form and no longer textual [4]–[8]. The spiritual narrative then becomes a visual rhetorical language through the shapes and scenes in each of the Borobudur relief

panels (Gifford, 2011). Borobudur Temple is believed to provide a new spiritual experience through reliefs as a form of applying visual perception [6], [7], [9].

As far as the researcher's understanding, the reliefs of the Borobudur temple have a visual communication function. There is an information pillar from a scientific point of view of visual communication design that is offered through these reliefs. The relief functions as an information and educational medium in the form of a visualization of Buddhist scriptures. The reliefs of the Borobudur temple as a medium of information cannot be separated from a form of telling the messages to be conveyed. There is a process of textual interpretation of Buddhist scriptures into story visualization on each relief panel.

The researcher reviews that there is no model of interpretation of Buddhist spiritual stories in the Buddhist scriptures for relief visualization. In addition, the method of telling the reliefs of the Borobudur temple has not yet been revealed. In the opinion of researchers, this is an important design issue to be explained and disseminated. The problem of discourse on how to communicate visual reliefs can be proven by the absence of literature that clearly studies the methods and models for telling the reliefs of the Borobudur temple. Currently the available discourse is more on the meaning of relief images and visual language coding.

Based on the background above, the researcher sees the potential to interpret and analyze the relief storytelling method in a three-dimensional perspective through the creation of works in three-dimensional (3D) format to explain the relationship between space and time.

This study is motivated by problems related to the lack of discourse that explains the textual interpretation of Buddhist scriptures and the method of visualizing storytelling in the reliefs of the Borobudur temple. Therefore, this research is important to do by asking the following research questions, firstly, how is the narrative of the reliefs of the Borobudur temple in a three-dimensional perspective? Second, what are the stages in interpreting relief visualization from a tridimensional perspective? The last, what kind of aesthetic experiences do you have when you enjoy photos of reliefs and visualization of storytelling through 3D prototypes of Borobudur temple reliefs?

Visual language, as a result of Primadi Tabrani's research, offers visual language principles that can be used to analyze images that tell stories. The visual language coding, Flat-Space-Time (RWD), sees an image as a passage of time and not a freeze of space & time. It is different from the Naturalist-Perspective-Momenopname (NPM) visual language system, which is a way of drawing by freezing space and time [10]. NPM is a tupa language system that developed from the world of western academics, while EWD is Primadi Tabrani's invention as a way of drawing with the dimensions of space and time.

In 2017, Tom Chandler, Brent McKee, Elliott Wilson, Mike Yeates, and Martin Polkinghorne initiated the Angkor Wat Virtual project. This project is an interactive simulation of the Angkor Wat archaeological site in Cambodia [11]. The Angkor Wat Virtual Project was carried out as a development of the animation project entitled Visualising Angkor which was produced and continued to be developed by Tom Chandler and Martin Polkinghorne from 2007 to 2014 at the Monash Faculty of Information Technology's SensiLab.

The Borobudur 3D VR game project was created to create immersion conditions in games with spiritual experience content. This project offers a new virtual experience concept called dynamic contemplation in terms of interaction aesthetics [4]. The Borobudur 3D VR game adapts the story of the Rabbit on the Jatakamala relief panels 23 – 25 in the Borobudur temple, part of the first ledge on the east side towards the south side [12] and adaptation of the Jatakamala book by Aryasura (400s AD) [13].

The documentary film "Learning from Borobudur" (1989) produced by Ruedi Hofmann and Fred Wibowo as a medium for learning arts, culture, spirituality and society (http://www.savpuskat.or.id/) [14]. This film by SAV Puskat won the First Prize Feldafest (1990) and the Golden Award from the Transtel Prix Futura (1991). This documentary film work offers a new experience in understanding the narrative on the reliefs at Borobudur temple. The interesting thing about this work is the re-illustration of the appearance of the relief through color images.

2   Research Method

This creation research uses a practice-led research methodology. This research methodology is part of artistic research that is developing in the current era. Berridge in [15] describes this practice-driven research process by exploring the ways in which information can be processed to form chunks of images and text. The process can occur in a circular and spiral. The reading of data and information influences visual, and text works as well as the choice of content for writing by artists/ designers. So that this stage will influence the direction of study and data collection. In other words, further dialectics will be born through the relationship between theory and practice. The main emphasis in this artistic research lies in the relationship between the nature of practice and the results of research that will encourage new knowledge which has operational significance for practice [16].

In [17] Kenna emphasizes that this practice-driven research has a focus on design principles and methods needed by designers to deal with art and design challenges. This research methodology can be carried out through developing practical experimental work methodologies and providing practical examples for testing the methodology and demonstrating the practical research findings. This artistic research contributes to the definition of artwork/ design that is currently developing so that it can assist designers in their creations.Please note that the first paragraph of a section or subsection is not indented.

This Borobudur Temple relief interpretation research can be divided into two stages, which are:

2.1   Preparation

In the preparatory stage, for the first time, a sampling selection of the reliefs contained in the Borobudur temple was carried out through the selection of relief photo documentation. After that, a literature study was carried out based on the relief choices

that had been determined. This literature study aims to synchronize visuals with textual stories based on Buddhist scriptures and Buddhist spiritual stories.

The next stage is tracing the properties contained in the reliefs. This tracing process will produce lithography on each predetermined relief. After that, identification and description of properties, characters, and other assets are carried out. The identification and description stages are carried out by interpreting based on facts in nature as well as the results of research on animals, plants, and other objects in the reliefs.

2.2   Implementation

The results of making lithography are also used for three-dimensional perspective interpretation. Interpretation of this three-dimensional perspective is carried out to obtain a three-dimensional realistic environmental conceptual. The conceptual interpretation is the basis for making projected images that look to the front, top and sides. This 3D projection image serves to build a three-dimensional environment lay-out concept for each relief.

The next process is to perform 3D modeling on each identified asset. 3D modeling is done with a 60% similarity level with the relief. This needs to be emphasized because of the decorative elements in the reliefs of the Borobudur temple. After the 3D modeling stage is complete, the texturing and lighting processes are carried out. The final process at this implementation stage is the preparation of assets and the application of the lay-out concept to each relief so that a digital prototype of storytelling in a three-dimensional perspective is produced. Researchers need to compare the results of the lay-out based on projected images with stories from textual sources. Modulation is still being carried out to suit the narrative based on Buddhist literature and scriptures that the researcher refers to.

3   Data and Discussion

In this section we will discuss it in several parts. In general, the data obtained from this study are in the form of pictures and qualitative descriptions.

3.1   Reliefs Determination

This study uses five reliefs as sampling to investigate the narrative of Borobudur temple reliefs from a three-dimensional perspective. The determination of the five reliefs is based on several considerations, including: spatial complexity, model of iconization of figures in relief, potential development of viewpoints. The reliefs that the researchers chose are:

a.   Rabbit's self-sacrifice (Jatakamala relief)

Fig. 1. Self-sacrifice of the Rabbit (Jatakamala relief panel 25)

In this relief, it is told about the god Sakra coming down to earth by incarnating into Brahman to prove the good intentions of the Rabbit in teaching his friends about the virtues and sacrifice of life (panel 23). Rabbit's friends made offerings to Brahman. Monkeys offer fruits, Otters offer some fish, and Wolves offer a bowl of milk to the hungry Brahman (panel 24). While the Rabbit had nothing, so he sacrificed his body as an offering to Brahman by jumping into the bonfire. Dewa Sakra really appreciated this good deed, so he gave appreciation and respect to the Rabbit by decorating the moon with a shadow image of a rabbit to accompany Dewi Candra at night.

b.   Swans on Lake Manasa (Jatakamala relief)

Fig. 2. Swan relief on Lake Manasa (Jatakamala relief) (https://www.photodharma.net/Indone-sia/04-Jataka-Level-1-Top/images/077-The-Geese-in-Lake-Manasa-Thumb.jpg)

In this relief panel, you can see the swans that live in Lake Mānasa. One of the swans is a Bodhisattva, an enlightened being [18]. It is likely that the Bodhisattva in this relief is the large swan at top left (Dhṛtarāṣṭra - king of the swans) standing on a large Lotus, and Sumukha (chief of the swans) just below him on the right [19]. Beneath the two geese are the common geese of the swan king Dhṛtarāṣṭra's followers. Now the lake is called Lake Mansarovar which is located in Tibet, the route from Uttarakhand connects it with India). Lake Mānasa is a holy place for Hindus and the lake is believed to be the abode of God Shiva and Goddess Parvati [20].

c.   The King distributes alms (Jatakamala relief)

Fig. 3. Relief of the King Distributing Alms (Jatakamala relief) (https://www.photo-dharma.net/Indonesia/04-Jataka-Level-1-Top/images/202-The-King-distributes-Alms-Thumb.jpg

A king who left his kingdom and distributed alms to some people in need. In this relief panel, the king is giving alms to a brahman. Behind the king, there was a maidservant carrying an umbrella and fly repellent. The king was surrounded by his people begging for alms. This can also be seen in the relief panel which continues to display queues of people waiting for alms from the king.

d.   Forest and animals (Jatakamala relief)

In this relief panel, there are several animals with a forest environment as a background. It is clear, that the animals that are gathering, namely elephants, deer, buffaloes, and wild boars on the ground. There are also peacocks and other birds in the trees, although they are not very visible. At the back of this forest environment appears rocks. The animals are watching the scene in the next relief, namely the scene of the Ruru deer saving humans.

Fig. 4. Forest and Animal Reliefs (Jatakamala reliefs) (https://www.photodharma.net/Indonesia/04-Jataka-Level-1-Top/images/095-The-Forest-Animals-Thumb.jpg)

e.   Sudhana visits God Shiva Mahadeva (Gandhayuha relief)

Fig. 5. Relief of Sudhana Visiting God Shiva (Gandhayuha relief)

This relief shows Prince Sudhana meeting his 29th spiritual teacher, namely God Shiva Mahadeva. Based on the text of the Gandavyuha Sutra, this prince Sudhana is on a journey to seek enlightenment of the Buddha (Panyadewa, 2014). God Shiva, who has four hands, sits on Nandi's cow when he meets Sudhana (Fontein, 2012). The illustration of the scene shown is God Shiva teaching prince Sudhana to do dharma or goodness.

3.2   Lithography Making

At this stage is the process of converting relief images into line drawings which we then refer to as lithography. Even though the manufacturing process does not use a stone

printing system like the original concept from ancient lithography, in this study a tracing process was carried out on relief photos. The researcher conducted two technique trials, namely direct tracing, and contrast techniques on the outline of each element. The results of making lithography using the direct tracing method by following the outside of the objects on the reliefs. The following is an example of the tracing process that was carried out and followed by displays of the tracing results (shown in Figure 6.).

Fig. 6. Tracing Process Based on a Photo of the Relief Panel

Following are the result examples of tracing which produces lithography based on the five reliefs that have been selected:
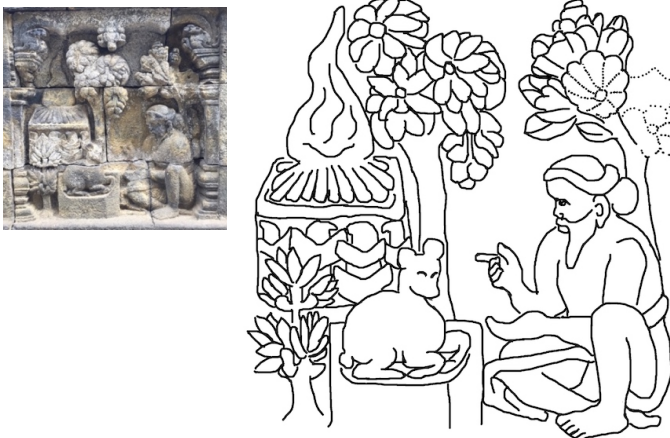
Fig. 7. Lithography of Rabbit's self-sacrifice
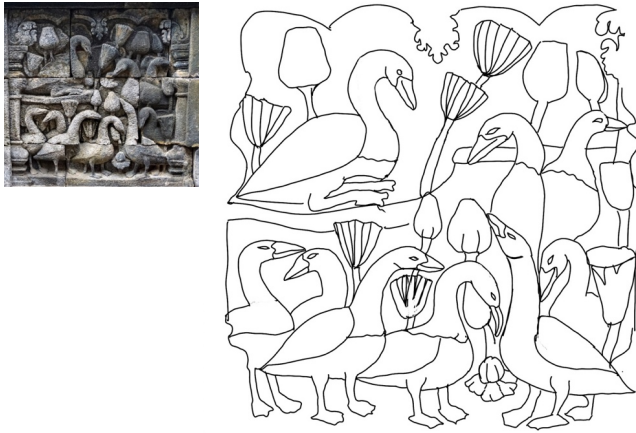
Fig. 8. Lithography of Geese in Lake Manasa
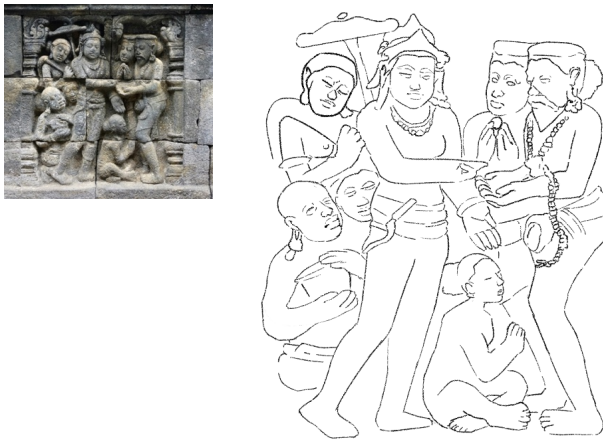
Fig. 9. Lithography of the King Distributing alms

Fig. 9 is a lithography that used the second technique, namely by adjusting the border contrast, although this technique is not optimal. The lithography in Figure 11. above seems to be the result of scanning and losing the artistic side of the artist (lithography maker). The lithographs above help researchers to identify and describe every object contained in each relief panel. The following is a sampling of the identification and description of one of the relief panels. In Figure 12. below, you can read the identity of each object on this relief panel. Names of divine figures, plants, animals, and other properties. The identification of this object is in accordance with the story of the Rabbit based on the literature in the Jatakamala scripture.

Based on Fig. 10 below, there is a conformity between the description of the scene in the story of the Rabbit with the literature and the Jatakamala scripture. The scene in the lithography above talks about the conversation between the Brahmins who are asking the rabbit's determination to sacrifice himself as an offering to himself as an incarnation of God Sakra. With firm determination, the rabbit jumped into the bonfire to offer his body to the Brahmin. God Sakra paid homage to the rabbit's self-sacrifice. God Sakra remembers the courage, sincerity, and kindness that the rabbit had done by decorating the moon with the silhouette of the rabbit's body.
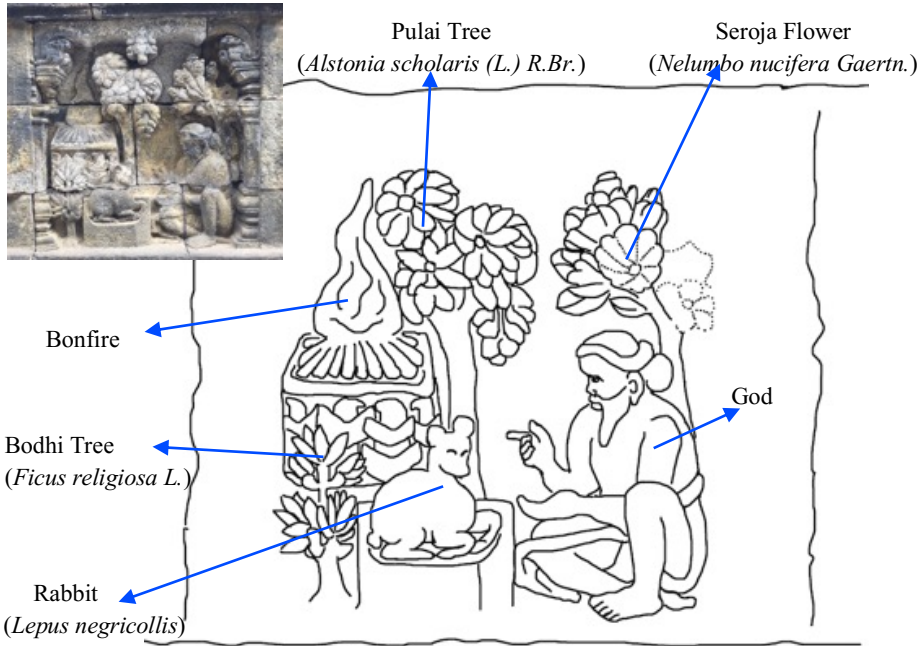
Fig. 10. Identification on the Rabbit Self-Sacrifice Relief Panel

3.3   3D Asset Creation

The relief identification results are used to help determine the shape of the 3D asset that will be created. 3D assets are created through the 3D modeling process. However, before the 3D modeling process is carried out, it is necessary to create a model sheet as a guide in modeling 3D assets. The model sheet was also created based on the results of the relief identification previously carried out. 3D model artists carry out modeling referring to the model sheet. So that the interpretation does not deviate far from the original form according to the identification results. Some examples of the results of making model sheets as follows:
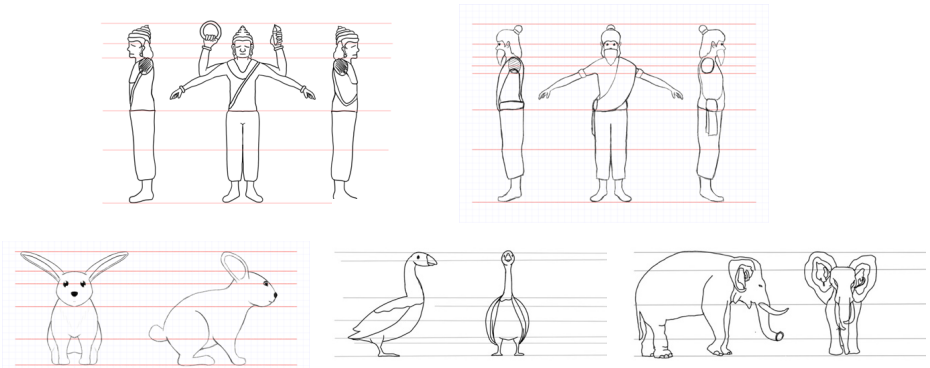
Fig. 11. Example of 3D Sheet Model

Next is the 3D modeling stage. This three-dimensional model asset is the basic form, and the following is an example of modeling results which can be seen in the image below (see Fig. 12).

Fig. 12. Example of 3D Asset Modeling

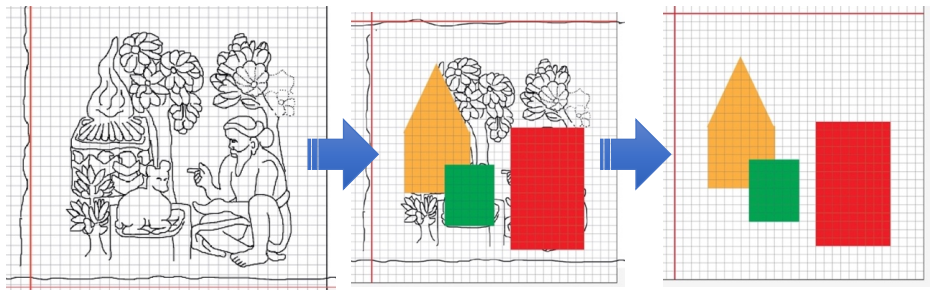## 4   Three-dimensional Perspective Interpretation

Fig. 13. Changes from lithography to box shape

The stages of interpretation into a three-dimensional perspective are basically translating a two-dimensional perspective into three dimensions (two-dimensional to three-dimensional). This study uses the 2D to 3D projection method. Briefly, the process

begins with replacing objects in lithography using a geometric shape (like a box shape), as shown in Fig. 13 above.

After obtaining the front view layout, then this image is projected onto the top view layout and side view layout, as shown in Fig. 14 below.
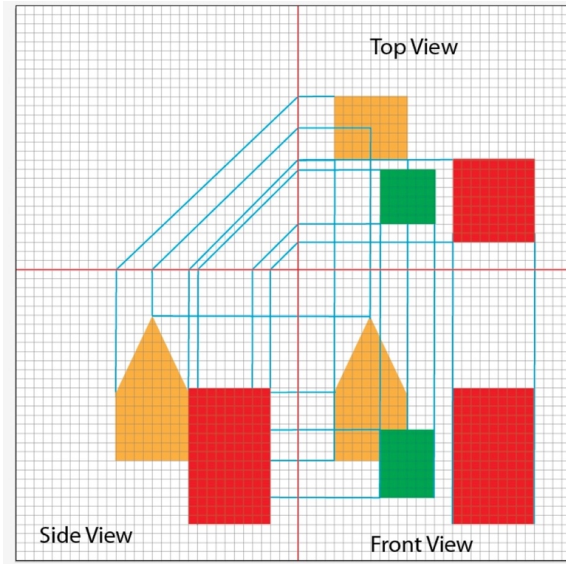

Fig. 14. Example of 3D Projection Process

In this study, the 3D projection results from the top view are used as the basis for determining the three-dimensional perspective spatial layout. The camera point of view is determined based on the interpretation of the scene and characterizations that will be conveyed to the audience. Referring to the 3D projection from the top view, the spatial layout of each relief can be determined to build a three-dimensional perspective environment. The example of the results of the 3D assets visualization in a three-dimensional perspective are as follows:
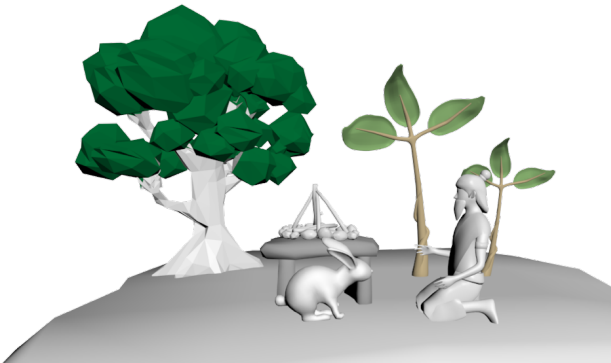

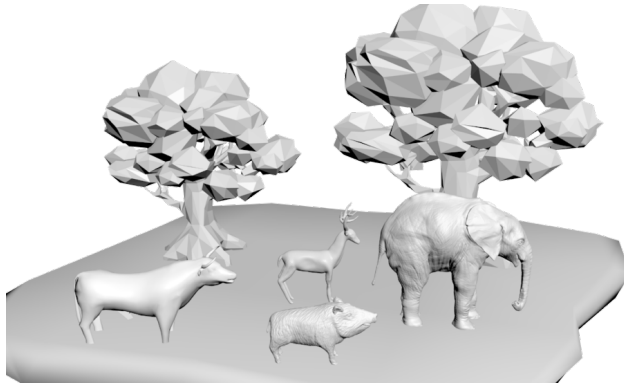**Fig. 15.** 3D Visualization of the Rabbit's self-sacrifice

Fig. 16. 3D Visualization of the Forests and Animals

Fig. 17. 3D Visualization of Sudhana Visiting God Shiva Mahadeva

Apart from referring to the results of the 3D projection images from the top view; the researcher also compared the five relief stories selected from the Borobudur temple with Buddhist literature and scriptures in the process of determining the position of 3D assets. This is possible because the projection process is basically an interpretation process using perspective lines. This means that it cannot be standardized, however can provide a similar 3D perspective pattern. So that the 3D projection method can be used to interpret the relief into a 3D perspective, of course, modulation is still needed so that the image looks livelier and makes sense.

5   Conclusion

In general, relief can be interpreted into a 3D perspective by using the image projection method. However, determining the layout of 3D space needs to consider the storytelling based on the contents of the story in literature and scriptures. This means that research-

ers are still looking at the possibilities of subjectivity that can be developed in the creation of art works and designs. This diversity can be triggered by life experiences and interpreting spiritual meaning in creating artworks.

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