Digital Press Social Sciences and Humanities

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Assajie Satyananda, R. Krismono and and T. W. Yudialim

Nirbana: A Relief Identification System (SIRel) Based Android Application As An Effort of Indonesian Noble Values Implantation

Assajie Satyananda[1,*], R. Krismono[2], and T. W. Yudialim[2]

1 Departemen Arkeologi, Fakultas Ilmu Budaya, Universitas Gadjah Mada, Yogyakarta, Indonesia
2 Jurusan Ilmu Komputer, Fakultas Matematika dan Ilmu Pengetahuan Alam, Universitas Gadjah Mada, Yogyakarta, Indonesia

*e-mail: assajie.s@mail.ugm.ac.id

Abstract

Candi is one of the most important cultural heritage which contains a lot of important values for Indonesian peoples. Those important values are being stated in many relief carvings on the Candi's walls. These relief carvings reflect the values of life that should be applied by mankind. Moreover, relief carvings also reflect Indonesian national history and cultures which is a reflection of the nation's identity and character. This research intends to design an application named *Nirbana*. *Nirbana* utilizes Unity Program as an image, audio, and texts processing software, Vuforia Program as an Augmented Reality processor for smartphones, and Augmented Reality technology as an output media in the form of visual graphics, this entire unit is incorporated into a system called Relief Identification System (SIRel). This application is expected to be a solution for the problems experienced by Indonesian people who have difficulty in accessing information about relief carvings in Candis. *Nirbana* is expected to be a prototype for every cultural heritage management in an effort to exploit the potency of technology for the benefit of Indonesian cultural education. Moreover, this program is targeted to become a medium to socialize and instill Indonesian noble values to the present and future generations.

Keywords

cultural heritage, relieve carving, SIRel

1 Introduction

Candi as a cultural heritage monument holds a lot of important values for Indonesian people. These Important values are carved in the form of relief carvings which were carved on the wall of candi. The reliefs carved on the walls of the candi reflect the teachings of the values of life which should be able to be applied by humanity. Moreover, reliefs could become a guide for humans to behave in accordance with the values taught by religions. Relief carvings also reflect the richness of the nation's history and culture which becomes the reflection of Indonesian people's identity and character. (Balai Pelestarian Cagar Budaya Jawa Tengah, 2015)

Some of the story relief carvings on the temple buildings are recognized as masterpieces of the ancestors of Indonesian people, namely relief carvings contained in Candi Borobudur, Candi Prambanan, and Candi Sojiwan. Moreover, the relief carvings in Candi Borobudur and Prambanan has been acknowledged to have an Outstanding Universal Values (OUV) by UNESCO which make these two temples are being recognized as a World Heritage (**Fig. 1**).

Fig. 1 Candi Borobudur Relief

Among the relief carvings of Candi Borobudur, There is the relief group of Lalitavistara which tells the story of the life journey of Buddha Sidharta Gautama from when he was still in the Svarga Tushita as a Bodhisattva until he reached enlightenment as a human (Asyari, 2011). Candi Shiva and Brahma, which are two of three main temples of Candi Prambanan, contain the teachings of national love, loyalty, and devotion. Meanwhile, in Candi Sojiwan, there is a group of Tantri relief carvings containing a lot of moral teachings. Every single one of these relief carvings contains lessons and noble values that are worth knowing and to be passed on to anyone who visits the temples (ibid).

The noble values contained in the temple relief carvings as described above apparently were not accommodated by good accessibility so that the noble values could be conveyed to the people of Indonesia (Krismono & Satynanda, 2018). This assumption is based on the result of a survey conducted by the team, which showed that 77% of 100 visitors in Candi Borobudur did not understand the content of the Lalitavistara relief. In fact, many efforts have been made to socialize the teachings and noble values contained in the relief carvings (Lelono, 2016). These efforts are in the form of books, online publications, brochures, museums, and tour guides provided by various agencies and travel agencies. However, these efforts are not yet proven effective in conveying the noble values and teachings contained in the relief carvings.

Based on this problem, the team aspired to create *Nirbana*. *Nirbana* is an android-based software that can be accessed by smartphone. *Nirbana* utilizes Unity, Vuforia, and Augmented reality software, which are integrated into the Relief Identification System (SIRel) of *Nirbana*. Unity software is applied to process images, sounds, and text. Vuforia serves to detect and identify the relief carvings, Augmented reality produces output in the form of visual graphic animation (Kysela & Štorková, 2015; Nugroho & Pramono, 2017).

Augmented reality technology which is utilized by *Nirbana* has actually been utilized in various fields. However, its usage in the field of cultural heritage management are still limited, this also includes the direct identification and reading of relief carvings. In this case, *Nirbana* could become an effective, innovative, and strategic solution to improve the quality of visits to the temple sites, through exploration and continuation of the national noble values.

2 Methods

The realization of *Nirbana* program was carried out in four stages, which is 1) Preparation and Planning stage, 2) Data Collection, *Nirbana* Program Design, SIRel Design, and Content Data Collection stage, 3) *Nirbana* Programming stage, and 4) Trial and Evaluation stage.

2.1 Preparation and Planning

This stage includes administrative preparation such as applying permit to collect data on the temple sites addressed to Balai Konservasi Borobudur, Balai Pelestarian Cagar Budaya Daerah Istimewa Yogyakarta, and Balai Pelestarian Cagar Budaya Jawa Tengah. Furthermore, this stage also includes inventory listing and purchasing required equipment to support the data collection process. Moreover, This stage includes sketching the system and appearance design and followed by installing the required tools to build *Nirbana*.

Digital Press Social Sciences and Humanities 4: 00002 (2020)
Proceeding of Indonesia Heritage Tourism Forum 2019 (IHTF 2019)

https://doi.org/10.29037/digitalpress.44349

Lastly, to specify which relief panel will be used as samples and literature study to support the information of relief carvings.

2.2 Data Collection *Nirbana* Program Design, SIRel Design, and Content Data Collection

Data collections in the form of information about certain relief and relief photograph samples were taken at Candi Borobudur, Candi Prambanan, and Candi Sojiwan. This process took twelve days to finish, including four days in Candi Borobudur, four days in Candi Prambanan, and four days in Candi Sojiwan. The relief selected as samples have to meet certain criteria such as, fully intact, have a complete component as a relief, clean of moss, and has an optimal display for photographs. Selected reliefs are then photographed and the results are being resized to obtain a size that matches the database requirements. The resized relief photographs are used as a dataset that holds all information related to certain relief.

The design making was carried out in two stages. These include sketching on paper and sketching on Android Studio. Several sketches on paper were made. These sketches include the main menu design, the temple selection menu, the scanner display, the library menu, and the help menu. Hereafter, these sketches are being implemented into the Android Studio as the application design. SIRel design making processes were started by installing the studied Unity and Vuforia tools. These tools are then integrated and further perfected by adding an Augmented reality feature as its output. The overall combination of Unity, Vuforia, and Augmented reality is being called as the Relief Identification System (SIRel). (**Fig. 2**).
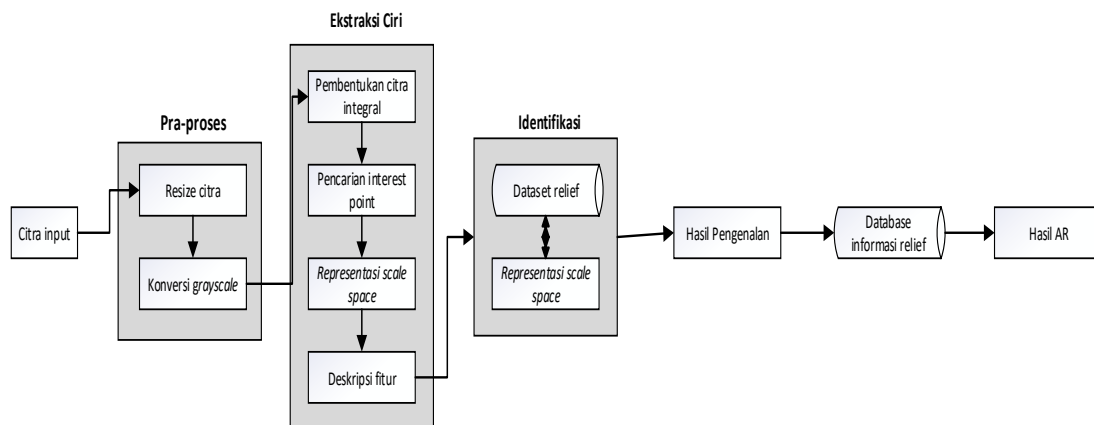

Fig. 2 Relief Identification System (SIRel)

Content creation was done by interpreting the meaning contained in relief by using the results of the literature study. The information obtained are then translated into text, recorded audio, and animated graphics and then generated in the form of Augmented reality. To further enrich the feature, *Nirbana* is available in Indonesian and English language.

2.3 Nirbana Program Building

Nirbana is created by combining the results of object development through Unity and Vuforia as its output media. The results are then exported and processed using the Android Studio. In Android Studio, *Nirbana* application was built, starting with the design of the main menu page, the temple selection menu, the scanner display, the library menu, the help menu, and the exit menu. This step ended with uploading *Nirbana* program to the Android Play Store (**Fig. 3**).

Fig. 3 Application making stages

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2.4 Trial and Evaluation

The tests were conducted on two different media, one was on the printed relief carving images and the other was directly conducted on the actual relief carvings on the temple sites (See **Fig. 4**). Nirbana test with printed relief carving images has been conducted at the Faculty of Mathematics and Natural Sciences, Gadjah Mada University, under the direct supervision of Drs. Agus Harjoko, M.Sc., Ph.D. Tests on printed relief carving images show that *Nirbana* works following the initial design. The expected program output in the form of Augmented Reality texts, audio, and visual graphics animation also works properly. Meanwhile, direct tests on the real relief carvings in temple sites have been carried out under the supervision of the Head of the Borobudur Conservation Center and witnessed by both local and foreign temple visitors. On direct testing to the actual relief carving, *Nirbana* also works properly in accordance with the initial design.
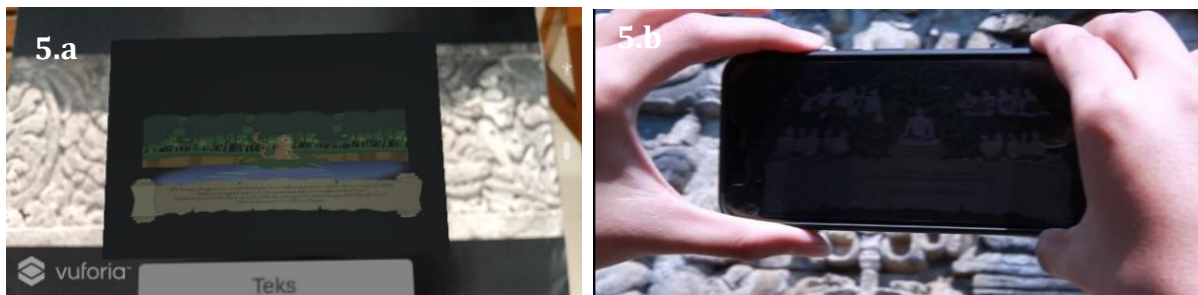

Fig. 4.a. Test on Printed Relief Carving Image, **4.b.** Test on Actual Relief Carving Image

There are no significant problems with the test on printed relief carving images. However, while testing on the actual relief carvings in Candi Borobudur, SIRel did not work quite rightly. The reason behind this problem was caused by the yellowish-white color on the relief carvings which reflects light. Moreover, the Sunlight intensity which changes at almost every hour made the SIRel could not identify the reliefs because light reflection and intensity affect the color of the image captured by SIRel. If the image captured by the SIRel is different from the picture used as an identification reference, then the SIRel won't be able to recognize the captured image.

This problem was solved by retaking the reference picture of relief carvings while observing the changes in light intensity and color of reflected light on the relief carvings for one full day. After being provided with various image reference with different lighting and color variation, SIRel can work in accordance with the initial design

3 Result and Discussion

3.1 Result of Nirbana Software Development

3.1.1 Nirbana Program

Nirbana home page display contains several menu options consisting of "Scan", "Library", "Help", and "Exit" (**Fig. 5**). The "scan" menu contains the "Select Temple" page. On this page, users can choose which temple is being visited by the user. There are three choices of temples consisting of Candi Borobudur, Candi Prambanan, and Candi Sojiwan. After the user chooses the temple, the system automatically opens the smartphone's camera which could scan the relief carvings following the chosen temple. Hereafter, by directing the camera to the relief carving, then SIRel can identify the relief carvings which are being scanned. If SIRel could recognize and identify the relief carving, *Nirbana* will automatically show the information in the form of text, audio, and visual graphic animation. Users can choose between outputs freely with the provided menu. In the library menu, users can access information about the temple they visited, such as temple information, temple restoration record, how to read reliefs, and temple profiles that are equipped with pictures. On the help menu, users can find information about *Nirbana* which consists of how to use *Nirbana* and about the *Nirbana* itself. In the exit menu, users can exit the *Nirbana* program. The *Nirbana* program can be downloaded at the Play store and can be operated on an Android smartphone.

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https://doi.org/10.29037/digitalpress.44349

Fig. 5 Nirbana Program Display

3.2 Relief Identification System (SIRel) Working System

Nirbana works using an integrated relief identification system (SIRel). The SIRel can work by taking an input image using a smartphone camera. When SIRel captures the input image, SIRel will automatically extract some certain features that exist on the object captured by the camera, in this case, the relief carvings on the temple. After the temple reliefs are identified, SIRel will compare, sort, and synchronize with the existing database. When it successfully synchronized, SIRel will display the information about relief stories in the form of Augmented reality text, audio, or animation with a choice of Indonesian or English language that can be freely chosen by the user. (**Fig. 6**).
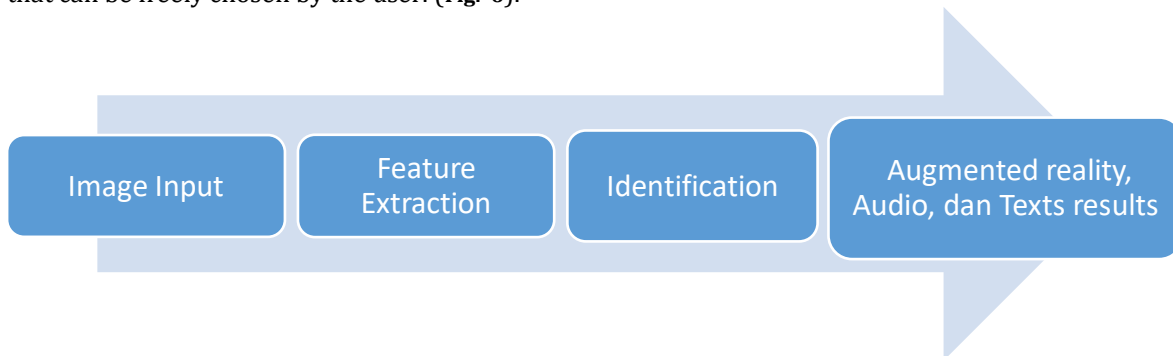

Image Input — Feature Extraction — Identification — Augmented reality, Audio, dan Texts results

Fig. 6 SIRel Working System

3.3 Relief Identification System (SIRel) Working System

Implementation of *Nirbana* has been carried out by temple visitors at Candi Borobudur, Candi Prambanan, and Candi Sojiwan. *Nirbana* has been proven helpful to obtain information about temples and temple reliefs quickly, easily, with accurate information and without incurring any costs for the temple visitors. In fact, Retno, a teacher from SMAN 19 West Jakarta, claims that *Nirbana* is very helpful for the process of teaching the cultural and noble values of the Indonesian people to their students.

Moreover, evaluation and trial have been carried out by cultural heritage expert Drs. Djaliati Sri Nugrahani, M.A., and computer expert Drs. Agus Harjoko, M.Sc., P.hD. the result concluded that *Nirbana* can work according to its function, and is suitable to be implemented at Candi Borobudur, Candi Prambanan, and Candi Sojiwan. There are some important critics on *Nirbana*, such as enlarging the application memory size so that it would be much bigger when more data were added into the system. Lastly, the comparison between *Nirbana* and conventional methods such as book, tour guides, and brochures is presented below:

Table 1 Comparison between Nirbana and Conventional Methods

Conventional Method (book, tour guides, brochures)	Nirbana
More expensive with limited information	Cheaper with a wider range of information
Limited on temple site only	Practical, could be used anywhere and anytime
Information is difficult to access	Fast and easier to access
Less attractive	More fun with more interactive and educative information

4 Conclusion

Relief Identification System (SIRel) based *Nirbana* has been created and used by visitors in the Candi Borobudur, Candi Prambanan, and Candi Sojiwan. The testimony from visitors of the three temples concluded that the visitors can easily learn and understand the noble values that exist in the relief carvings on the temple. Therefore, *Nirbana* is believed to be an effective medium for Indonesian national noble values implantation

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