Augmented Reality (AR)-Based Application to Introduce Nagasepaha North Bali Puppet Style Character

L J E Dewi¹, A A J Permana², I K Purnamawan³ and I K Sudadana⁴
Informatics Management, Universitas Pendidikan Ganesha, Singaraja, Indonesia

Email: joni.erawati@undiksha.ac.id¹, agus.aan@undiksha.ac.id², purna@undiksha.ac.id³, ikomangsudadana@gmail.com⁴

Abstract. Tourism is a mainstay of Bali’s original source of income. The object of tourist attraction in Bali is nature, culture, and a combination of nature and culture. Buleleng is located in the north of Bali. Besides being famous for its stunning underwater scenery, it also has cultural richness in the form of shadow puppet craft. The purpose of this study was to create an Augmented Reality (AR) -based application of shadow puppet characters which were the handicrafts from Nagasepaha village, Buleleng. This AR application uses smartphones as shadow puppet recognition media for children or young generation virtually. So, the process of introducing shadow puppet becomes more interesting and easy to use. Users can run the application, then the application performs marker tracking. If the marker matches the reference data contained in the application, the application displays the shadow puppets in 3D on the smartphone screen. The information displayed is the name of the shadow puppet character along with the accompanying attributes, animated shadow puppet, the voice of the puppeteer who describes the puppet character. The shadow puppet characters shown are from the Ramayana epic, namely Rama, Shita, Hanoman, Laksmana, and Rahwana. The presence of AR, it is expected to increase the love of the younger generation for shadow puppet artwork from the village of Nagesepaha which is an icon of cultural heritage from North Bali. The usability test is categorised good with the percentage is 84%. It’s mean the program is running well and ready to use by end user.

1. Introduction
As a civilized nation, Indonesian has to preserve their identity by acknowledging their art and cultural heritage. Puppet is one of the art heritages which appeared on the 10th century and puppet becomes World Masterpiece of Oral and Intangible United Heritage of Humanity. The appreciation was given by UNESCO on November 2003. UNESCO commits to preserves the puppet show existence. These needs supported to preserve the puppet on the modern days [1]. Puppet is theatrical show played by doll, human-like object, dummy building, or dummy animal. The art in the puppet show includes the tonal expression, drama script, musical instrument, and dancing movement. Puppet show can be found in Java, Bali and other part across the Indonesia archipelago. Puppet shows in Indonesia are various in styles, based on its origin.

Puppets are drama shows which employ human-like object, dummy building and animal made from leather. Puppet master is the one who perform the puppet show. Leather puppet has been appointed as the word oldest kind of puppet show by UNESCO. Leather puppet is critically
endangered. The leather puppet show is rarely held. North and South Bali has distinct puppet style, seen from its color, shape, characters. In the remote area of the North Bali, in the village of Nagasepaha, there is distinctive puppet found. Long time ago, Buleleng has two different style of puppet, east and west Buleleng style. However, only the Nagasepaha, east style exists till the present time. The west style is already extinct. Nagasepaha is located in the Sukasada district. Most of Nagesepaha people are farmer and artist. The field observation indicates that the Nagasepaha style is critically endangered.

Good will and effort must be developed to preserve and introduced puppet to young generation so they have understanding that puppet need to be preserve. Introducing puppet to international community is to make cultural understanding among the global community, foreign students are eager to learn Indonesia culture [3]. Puppets is media for transforming knowledge and value to younger generation [4]. However, the puppet is now abandoned by the Indonesia young generation. They consider puppet outdated and they prefer to watch foreign film on YouTube than watch puppet.

Research to preserve puppet has been conducted by introducing national figure in puppet character to fifth grade elementary school children, so they can improve their learning outcome [5]. The current technology development makes it possible for the people to receive information like script, images, audio and video. The technology development must be able to drive the people to recognize and preserve Indonesian art and culture especially puppet which is now classifies as endangered art.

Puppet shows are now introduced in 3D which presents the information of the puppet character, video, and the narration of the each puppet character installed on the Smartphone [6]. There is research [7] that develops Augmented Reality based wayang golek using real time digital camera, board marker, and computer where the user act as puppet master. The introduction of the puppet is also done in the form of card, as in the research [8] which puts 54 puppet characters on the playing card.

Big tech companies are now investing to develop advance technology. One of the companies is Microsoft that invented hololens adopted from the Augmented Reality (AR) technology. Augmented reality is technology that can connect the real and virtual word created by computer in real time. The technology can be used to introduce puppet to children and adult students through their Smartphone. The research found that the use of AR on learning can reduce students saturated. Considering the existence of the puppet in Indonesia and the advantages of the AR, the present research is conducted. The research is on the Augmented Reality (AR)-based application to introduce Nagasepaha North Bali Puppet Style Character. The characters are Rama, Sita, Hanuman, Lakshamana, and Ravana. The application provides information of the dress attribute, personality, and the dubbing of each characters brought by puppet master.

2. Methodology
Research methodology is technique/how the research is conducted [9]. The research method used in the research of ‘Augmented Reality (AR)-based application to introduce Nagasepaha North Bali Puppet Style Character is research and development (R&D). The R&D method is used to create and test the effectiveness of the application [10].

2.1 Process of Data Collection

The research is conducted in Nagasepaha village and Undiksha University. The research is 6 months long from the November 2017 until April 2018. The subject of the research is inanimate objects, animate object, thing, and places where variable is attached to. The subjects of the research are puppet master and puppet maker. The data of the research is the detail attribute of the puppet character such as jewellery used, sound of the puppet character and character of the puppet.

The attribute of the puppet was collected through observation and interview the puppet maker. The data was also gathered from the data of the former research in collecting and documenting the attribute of Nagasepaha puppet style. The documentation was taken from the puppet maker of Gede Kenak Arya. However he could not describe the attribute of each puppet character. Next was sound recording
of each puppet character, assisted by Jero Dalang from Bungkulan Village, the puppet master. After going through the process of discussion and conducting interviews, the person concerned can help the researcher to record his voice when performing Ramayana puppet plays such as the characters Hanuman, Rama, Sita, Lakshamana, and Ravana.

2.2 Introduction of Puppet Character
The research is discussing the shadow puppet characters taken from the Ramayana epic poem. The composer of the Ramayana epic poem narrates the struggle of the divine prince of Rama. The prominent characters in the Ramayana epic poem are as follows.

a) Puppet character of Hanuman
Hanuman is white monkey, the son of the Wind-God Vayu and Anjana. Brahma, the God of Creator blesses Hanuman with supernatural power that makes him unharmed by any kind of weaponry and Hanuman is also immortal. He symbolized the human excellence of inner self-control, resistance to persecution, faith and service to the cause.

b) Puppet character of Ravana
Ravana was born to a great sage Vishrava and his wife the princess Kaikashidaughter of King Sumali of Lanka Empire. Ravana is described mainly negatively in Ramayana. Ravana is great demon king who possess great mystical power of Rawarontek given by the King Danaraja and Aji Pancasona by the great sage Subali. Ravana assumed leadership of the Lanka Kingdom from his grandfather, Sumali, after he defeated his uncle Prhasta. Ravana conquered Lokaphala Kingdom and kill King
Danaraja. Ravana also attacked the Suralaya Kingdom and abducted Princes Tari, the daughter of God Indra and Viyati. Princes Tari become Ravana spouse and gave birth to Ravana Son, Indrajit.

c) Puppet Character of Rama
   Rama was born to Kaushalya and Dasharatha of the Suryavanshi Dynasty in Ayodya. Rama has three brothers. They were Lakshamana the of Keikeyi, Bharata and Shatrughna the son of Sumitra. Rama is portrayed as the best upholders of Dharma.

d) Puppet Character of Sita
   Sita is the adopted dougther of King Janaka and Queen Sunaian of Videha the rules of Mithila Kingdom. When Sita reached adulthood, King Janaka organized swayamvara in the condition that Sita would only marry that person who would be able to string Pitaka, the bow of God Siva. Sita is portrayed as symbol of purity and service to the cause.

e) Puppet Character of Lakshamana
   Lakshamana is the youngest brother of Rama, born to Dasharatha of the Suryavanshi Dynasty in Ayodya and Sumitra. Lakshamana is personified as a man with unwavering loyalty, love and commitment to his older brother. For the detail of the Puppet character can be soon on figure 1.

2.3 Augmented Reality (AR)
   Augmented reality is technology that can connect the real and virtual word created by computer in real time [11]. AR is the further developments of Virtual Environment (VE) well known as Virtual Reality (AR). VR connect the users to the virtual word so they cannot experience the real word anymore. AR works differently, AR enables the users to experience both the virtual and real word at the same time. AR is a complement of the real word. AR has components to support its operation, they are as follows:
   a. Scene Generator
      Scene generator is software responsible for picture rendering captured by camera.
   b. Tracking System
      Tracking System is the most important component in Augmented Reality. In the tracking process, the real and virtual objects are detected.
   c. Display
      In developing of AR based system, there are some parameters that requires intensive concern, that are optic and video technology. Both of the parameters are connected and dependent of the resolution factor, flexibility, tracking area and point of view.
   d. Augmented Reality Devices
      Media used for displaying object in Augmented Reality is optic virtual retina system, displaying video, AR based monitor, and AR based projector.

2.4 The development of the product
   Waterfall method is used in the development of the program. The method is mainly down steps. The steps are as follows:
   a) Planning
      The step was focused on collecting the data of the Nagasepaha style Puppet characters which were required in the AR based Nagasepaha style Puppet.
   b) Need analysis
      The need analysis was the first step in the Augmented Reality Based introduction of the Nagasepaha North Bali style puppet character. There was also data collection and data analysis conducted in the need analysis.
   c) System design
      System design includeds the designing the outline of the system design. The process in this stage was designing the flowchart diagram.
d) Coding
Coding was the personification of the system design to instruction understood by computer. Interface and program script were developed to produce the intended application.

e) Testing
Augmented Reality (AR)-based application to introduce Nagasepaha North Bali Puppet Style Character employed the black box testing. After discovering the bug, issues and weakness of the application the corrections were done to improve the performance of the application.

f) Operation and maintenance
The operation and maintenance steps included data backup, feature improvement to make stable application for future development.

2.4.1 Creating the puppet object (virtual)
Photoshop CS6 and Blender were used in the creation of the puppet object. The background was dropped, and then the part of the puppet body was put into parts, like the arm divided into two parts so it can move easily. After this process marker was created for vuforia by colouring the puppet black and put some detailed holes on it to create the shadow of the puppet. After the photo of the Nagasepaha puppets were put into part, the Blender application was used to make the 3D object of the puppet using the add-on image to 3D.

2.4.2 Creating the Vuforia
Vuforia was needed in the development of the augmented reality in Unity. Register and login on the previously made account. After acquiring the developer key licence, the licence key was created. Data base labeled as Wayang was created by selecting submenu target manager, in the menu develop add database was selected. Data based Wayang that has already created was selected and then add target and popup would appear.

2.4.3 Installing and configuring application in Unity 3D
The Latest Unity 3D is version 5 which has Vuforia as add-on default. The first step was downloading Unity 3D get it from the official website at www.Unity3d.com, ran and agreed the user agreement then select download Vuforia and android support, installing the application and waiting the process to finish. After the SDK was integrated then the add-on Vuforia was activated by selecting menu build setting and go to player setting and chose the android logo or it can chose the default mode and select XRS and choose Vuforia support.

2.4.5 The development of the android application
After completing the project the last step was ensuring the application running smoothly on android.
Table 1. The Result of System testing

| No. | Test Type | Result                        |
|-----|-----------|-------------------------------|
| 1.  | Marker size test |                               |
|     | large (100% - 50%) | Object appear                 |
|     | medium (50% - 25%) | Object appear with time span   |
|     | small (25% - 0%)  | Object disappear               |
| 2.  | Radian Test |                               |
|     | 0° -30°    | Object disappear               |
|     | 30° -60°   | Object appear with time span   |
|     | 60° -90°   | Object appear                  |
| 3.  | Feature    |                               |
|     | Open main menu | Running smoothly              |
|     | Exit the application | Running smoothly             |
|     | Select attribute button. | Running smoothly          |
| 4.  | Lightning  |                               |
|     | Outdoor (daytime)  | Object 3D appear              |
|     | Indoor (light on)  | Object appear with time span   |
|     | Indoor (light off) | Object appear with time span  |
| 5.  | Smartphone brand |                               |
|     | OPPO A3, Qualcomm MSM8916 Quad Core, RAM 2 GB | Running smoothly in the device |
|     | CoolPad, MT6735P 4inti 1.0GHz, RAM 3 GB | Running smoothly in the device |
|     | OPPO F1s, Eight Core, RAM 3 GB | Running smoothly in the device |
|     | ASUS Z010D, Quad-core 1.2 GHz Cortex-A53, RAM 2 GB | Running smoothly in the device |

Table 2. The Result of Usability User Test

| No | Komponen     | Persentase |
|----|--------------|------------|
| 1  | Word clarity | 80%        |
| 2  | Sound clarity| 86%        |
| 3  | Object clarity| 84%        |
| 4  | Dubbing clarity| 86%        |
| 5  | Attractiveness of the features | 84%        |
| 6  | Your respond to the application | 82%        |
|    | mean:        | 84%        |

2.5 Software Testing
Testing of the AR based introduction of Negasepaha North Bali Style puppet character application is to discover and report the quality, weakness and smoothness of the application. The testing was as follow: can be seen on table 1. Testing to discover the user satisfaction is also conducted as can be seen on Table 2 that are Word clarity, Sound clarity, Object clarity, Dubbing clarity, Attractiveness of the features, Your respond to the application is 84%, categorized as good to be developed and implemented. But, on the criterion of Word clarity need to be improved as it has low percentage, 80%, it indicates that word usage need to be improved. The respond on the application has percentage of 82%, it indicates that the user need to learn using the application. The dubbing clarity, the percentage is 86% that is good.

3. Result and Discussion
AR based introduction of puppet application has been successfully developed based on the initial blueprint. Steps in the development of the application were based on the waterfall method that are: system engineering, need analysis, design, coding, testing, and operation and maintenance. Alpha testing was used in order to discover and report issues within the application that need to be resolved.
The testing criterion are Marker size testing, Radian test, Feature test, lightning test, Smartphone brand test. The result of the test can be seen on the Table 1.

In the marker test objects can appear on large and medium size markers and cannot appear on small marker sizes. Objects can appear when the angle is 30o-90o. Then, application features such as menus, buttons, and information from the puppet can function properly. Related to lighting both inside and outside the application can run well. Then the application can run on several types of smartphones. After the application is tested on a different smartphone brand, it can run smoothly as expected. Usability testing in general runs well with a percentage of 84%, which means the program is very feasible to use the end user. In an effort to improve usability it is necessary to consider the use of letters that are interesting and liked by users, so that the user's response to the application can also increase.

Future application development is to improve application performance to run on all smartphone brands such as IOS, BlackBerry, and Windows Mobile. Then prepare puppet attributes to be directly attached to the human body.

4. Conclusion

Puppet which is Indonesian cultural heritage appreciated by the International community through UNESCO is worth saving. The puppet preservation is not only by arranging festival but also trough smartphone application. The research wants to introduce puppet to young generation by the Augmented Reality (AR) technology. The advance of the AR technology makes it possible to introduce puppet on the smartphone. Installing the application provide the user may have the access to attribute, sound, and personality of the puppet character such as Hanoman, Ravana, Rama, Sita, and Lakshamana. Pointing the camera to the puppet cart, user can enjoy the 3D image of the puppet on the Smartphone screen.

Application has passed the Usability test to obtain suggestion from the user mainly children and teenagers by giving questioner and application demo. The result of the test, based on the criteria of Alphabet clarity, Sound clarity, Object clarity, dubbing clarity, Attractiveness of the features, your respond to the application, is 84%. The result indicates that the application can be used and give interesting learning experience for the users. Future application development in a different operating system and puppet attributes to be directly attached to the human body.

5. Acknowledgment

Thank to everyone who involved and help the research, Jero Dalang from Bungkulan for dubbing the puppet, Gede Kenak Arya for giving information and documentation about Nagasepaha style puppet, research teams of Manajemen Informatika years 2017 who gave valuable data of the attribute of the puppet, and Manajemen Informatika family for their support to the research.

References

[1] S. R, “Wayang sebagai Warisan Budaya Dunia,” kompasiana, pp. 4–7, 2018.
[2] I. Rusliana, “Wayang Dalam Tari Sunda Gaya Priangan,” vol. 26, no. 2, pp. 151–165, 2016.
[3] Y. Bambang and M. Slamet, “CONSTRUCTING A COURSE ON INDONESIAN.”
[4] I. Nurasisiah et al., “Building Character And Literacy Skills Of Primary School Students Through Puppet Contemplative Sukuraga,” vol. 1, no. 1, 2017.
[5] E. R. Salamah, “PENGGUNAAN MEDIA WAYANG PADA PEMBELAJARAN IPS MATERI TOKOH TOKOH KEMERDEKAAN INDONESIA UNTUK MENINGKATKAN HASIL BELAJAR SISWA KELAS V SEKOLAH DASAR Evi Rizqi Salamah STKIP Bina Insan Mandiri,” pp. 57–65.
[6] I. K. Try, A. Stanaya, I. M. Suandana, A. Pandan., P. N. Crisnapati, “Aplikasi Augmented Reality Book and Stick Wayang Kulit Panca Pandawa Berbasis Mobile,” pp. 581–585, 2017.
[7] O. D. E. Wulansari and T. Zaini, “Pengembangan Kesenian Wayang Golek Virtual Berbasis Komputer Dengan,” vol. 10, no. 1, pp. 58–69, 2010.
[8] J. Wiyoso, “Puppet Visual Adaptation on Playing Cards as Educational Media,” vol. 16, no. 2, pp. 182–191, 2016.

[9] U. Ali, “Pengertian Pakar Pengertian Metode Penelitian, jenis dan,” pp. 1–8, 2018.

[10] I. A. Pratiwi, “Kata Kunci:,” Pengemb. Model KOLABORASI JIGSAW ROLE Play. SEBAGAI UPAYA PENINGKATAN Kemamp. BEKERJASAMA SISWA KELAS V SD PADA PELAJARAN IPS, vol. 1, no. 2, 2015.

[11] ujur indra Jati, “Membuat Aplikasi Augmented Reality bagian 1 (Membuat License Key, Database dan Upload Marker) Pengertian Dasar,” vol. 1, 2018.