

The Development of Shadow Play Wayang Kulit Using Augmented Reality

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Abstract— Augmented Reality (AR) is a current technology which creates a virtual object in a physical real world environment that creates a mixed reality. This paper describes the process of the development of an AR application augmented reality shadow play puppet- wayang kulit. Wayang Kulit is a traditional theatre that uses the principle of light and shadow accompanied with traditional music. Nowadays, the interest on wayang kulit among the young generation is slowly being fading out; efforts in terms of digitization would help to enlighten the valuable performing arts icon to the country. To preserve the country heritage, this study was conducted to introduce the art of shadow puppets in the form of application or a system that is easy for users to feel how to play wayang kulit. To create the application, the puppets are modeled in 3D graphic model and ARToolkit is selected as an application that overlays virtual imagery on the real world whereas Microsoft Visual C++ is used for developing the application. This application has a huge potential in promoting the wayang kulit and as an attraction as well as to promote the Wayang Kulit as one of the traditional art.

Index Terms— Wayang Kulit, Shadow Play, puppets.

1 INTRODUCTION

Shadow play has been around in many parts of Asia since ancient times in various cultures and languages. Shadow Play (or Wayang Kulit in Malay) is one of the most ancient shadow play theatres in Malaysia and one of the well-known traditional storytelling methods [1], [2], [3]. Puppet show is a popular form of entertainment and education throughout the world, used to teach morals and values to the audience in traditional societies [4].

The shadow puppet theatre performances in Malaysia were playing mainly in north and east coast of Malaysia. Wayang Kulit in Malaysia is threatened with extinction as the art play is slowly disappearing simply due to the lack of interest in the younger generation and also losing its identity as the heritage of country. Today it is played simply as culture performance in a tourist center instead in a yard in the village.

Some researchers suggested that in order to survive in the era of globalization, Wayang Kulit needs to be digitalized into the cyber world and to be watched on the computer screen [5]. There is a need to promote and provide greater accessibility and preserve this masterpiece using present technologies such as digital media [5]. Even though extensive research has been

carried out in virtual or digital storytelling, there are not much works are being carried out in virtual or digital shadow play [6].

There are some work by researchers in developing and digitalizing traditional shadow play development example wayang kulit application such as Wayang Authoring: A Web-based Authoring Tool for Visual Storytelling for Children [7], the Puppetwall system [8] and ShadowStory: Creative And Collaborative Digital Storytelling Inspired By Cultural Heritage [9]. Most of the work emphasized on digital storytelling of shadow play's work and creativity.

Therefore these reports proposed the development of shadow play puppet-wayang kulit using augmented reality to create the application, the puppets are modeled in 3D graphic model and ARToolkit is selected as an application that overlays virtual imagery on the real world whereas Microsoft Visual C++ is used for developing the application.

2 THE PURPOSE AND IMPORTANCE

Nowadays wayang kulit can be considered as an "endangered cultural" and there is a need to be preserved. Using a new technique the AR application that overlays virtual imagery on the real world, this would reach the effect that couldn't be observed on stage before. Therefore the purpose of this project is to transform the traditional shadow play into a new stage of development; the augmented reality wayang kulit application and to diversify and improve the use of technology in the wayang kulit show. This allows interactive play in real-time environment as well as producing realistic Wayang Kulit animation. With this application, the users will be able to experience for themselves how to play the wayang kulit but also get knowledge about the traditional culture.

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“Wayang Authoring”: A Web-based Authoring Tool for Visual Storytelling for Children [7] is an example of a web application about the *wayang kulit* that have been developed for visual storytelling for children .

In *Wayang Authoring* children are able to compose a story by using digital puppets, save, and share it. The wayang Authoring enables children to adopt many distinct characters and to act out moods, conflicts, and imaginative fiction in a safe environment.

PuppetWall is a multi-user, multimodal installation for collective interaction based on the concept of traditional puppet theatre. When interacting with PuppetWall, users hold a wand in their hands that controls a puppet on a large touch screen in front of them. The touch screen is used to manipulate the playground, which consists of characters, props, and a background. All visuals are created with a custom-made 3D graphical engine based on OpenGL libraries [8].

Real-Time Visual Simulation is a simulation puppet using sophisticated computer graphics techniques available in OpenGL in order to allow interactive play in real-time environment as well as producing realistic Wayang Kulit animation. It proposed a real-time method that allows interactive play of virtual Wayang Kulit using texture mapping and blending techniques. Special effects such as lighting and blurring effects for virtual Wayang Kulit environment were also developed [6].

The existing work on digital shadow play is not interactive and required specific hardware for users running the application. A better way of presenting shadow play is by allowing interaction and real-time play of shadow play need to be developed. Thus, there is a need for more research in real-time generation of shadow puppet images and interactive animation of the puppets.

3 SYSTEM IMPLEMENTATION

3.1 Character modelling and animation

The overall of system integration are shown in Figure 1, Integration starts with character modeling and animation. Animation is the most important assets for this project. There are two animation software used to develop the animation of this project it is Autodesk Maya 2011 and Autodesk 3ds Max 2011. The first step of implementation is objects or characters are created by using Autodesk Maya 2011 software and exported as a file wrl. After that, wrl will be imported into the Autodesk 3ds Max 2011 software to make animated or movement.

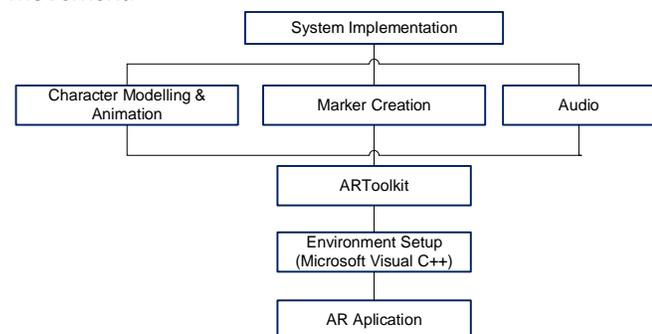


Figure 1. System implementation for Shadow Play-Wayang Kulit

The entire objects and model is created in Autodesk Maya 2011 and all the texture is applied in it. The entire model for this project is low polygon model which means that the polygon number is reduced as much as possible so that the application can execute in a minimum requirement state. The model is converted into .wrl format before it can be imported later in Autodesk 3ds Max 2011 software for editing and animation process. Figure. 2, Shows the character design used in shadow puppet.



Figure 2. Character Design

3.2 System Architecture

The system architecture for this project consists of AR engine, input and output devices, user and the main software used that is Autodesk Maya and Autodesk 3ds Max as shown in figure 3. ARToolKit is used to receive the information from input device and also updates the output devices. ARToolKit uses computer vision techniques to calculate the real camera position and orientation relative to marked cards, allowing the programmer to overlay virtual objects onto these cards. User can interact with the AR application by using the input and output devices.

The input devices consist of marker, web camera and mouse. However, the output devices used monitor to display and speaker to hear the sound clearly.

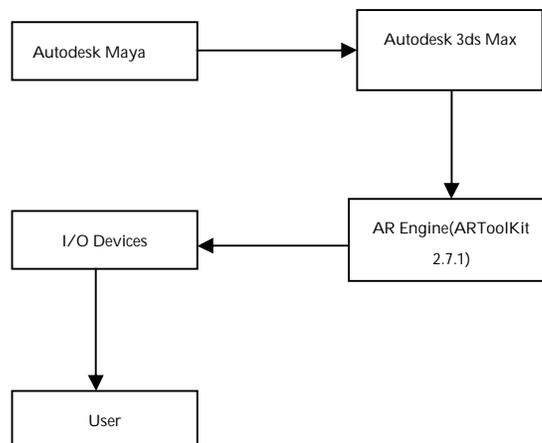


Figure 3. System Architecture

3.3 Metaphors

The theme for this application is traditional, classic, and old style. Since the model was created using low polygon model such as box and cylinder and sphere, all the object and model were applied textures so that the model will look as real. The textures include wood, carpet, and roof.

3.4 Marker Creation

The marker creation is a graphic drawn, printed, and shown to the AR application as it runs. ARToolKit, with help from the marker data file and parameters file, will detect this shape via webcam. To design a graphic, the desired shape must fit within a white square that is centered within a larger black square. Two types of marker created based on traditional wayang kulit character as shown in figure 4 below.



Figure 4. Marker Graphic Design

3.5 Audio

This song makes the background music when a marker card shown on the webcam and the song will be played. Background music is in MPEG-3 format with 44,100Hz of sample rate, 16-bit depth, and channel 2 (stereo). It was then converted to WAV format since the ARToolKit cannot playback the MPEG-3 format.

3.6 ARToolKit

ARToolKit is a software library for building Augmented Reality (AR) applications. ARToolKit is made available freely for non-commercial use under the GNU General Public License. These are applications that involve the overlay of virtual imagery on the real world [10]. AR Toolkit is a reliable library that very helpful to build an AR application.

AR Toolkit has been built based on computer vision method which is able to detect, calculate real camera position and direction relative to markers in real world during real-time transmission.

3.7 Environment Setup

Microsoft Visual Studio C++ is used for developing the application. ARToolKit libraries use C as the programming language. However, C++ is used for this project as C++ is an enhanced language to develop object-oriented structure of the application. The core of ARToolKit is composed of a main loop. As seen in Table 1, there are 6 steps of ARToolKit. The functions, which correspond to steps 2 through 5, run repeatedly from main loop. The AR application is published as .exe file when compiled the program code using Microsoft Visual Studio C++ 2008. Automatically, after compiled the .exe, files will remain in the ARToolKit folder. The 3D object in .wrl file, texture, audio and others library are the files which are loaded externally

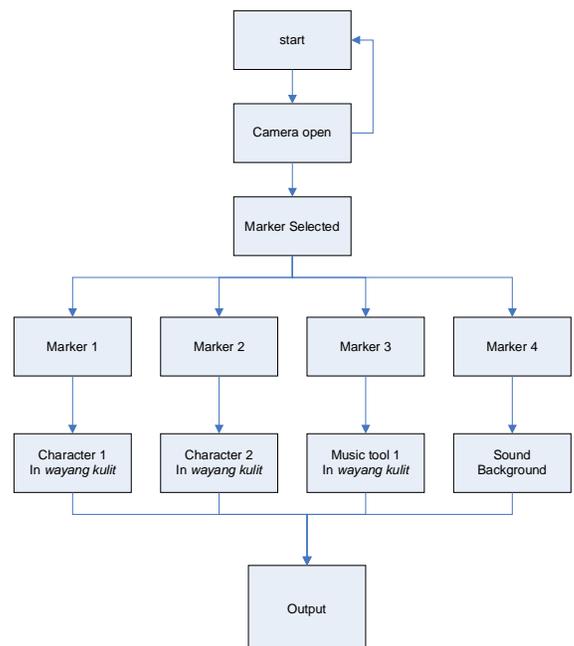
Table 1: ARToolKit Step and functions

ARToolKit Step	Function
1. Initialize the application	<i>init</i>
2. Grab a video input frame	<i>arVideoOpen</i>
3. Detect the marker	<i>arDetectMarker</i>
4. Calculate camera transformation	<i>arGetTransMat</i>
5. Draw the virtual object	<i>draw</i>
6. Close the video path down	<i>cleanup</i>

3.8 AR Navigation Workflow

AR application allows users to feel themselves like a real how to play wayang kulit. As shown in figure 5. The navigation flow will include the user interaction that allows the user to select one or more of the markers to be shown on camera and see the results. Besides that, users are free to move the marker and see the character models in three dimensions.

Figure 5. AR application navigation Flow



Web camera is user to capture the real time video frame and send to the computer. The computer will render the real environment based on the captured frame. Web camera is also act as an input for the computer to calculate the object position and orientation of 3D graphical objects will be displayed only when the marker is found.

Interaction with the system is based on the marker movements via the detection of the web camera. The monitor screen will display the interface of the application environment.

4.0 FUTURE WORKS

In summary, we propose a new approach to develop shadow play wayang kulit that is intended to enhance and improve the use of technology in the *Wayang Kulit* show by using Augmented reality.

Currently, the application can only display the object or model using the marker card. Therefore, the application will be improved better if it can detect something other than marker card such as human body.

For further improvement, this system can be improvise by develop in into teaching software. Since this system can pop up the animations, if it can be improve into software that can pop up, anything that in school syllabus to be teach to student, such as human body part or just simple numbers, it can produce an enjoying learning environment.

The use of Augmented Reality is believed has a potential in presenting a traditional art like the "*wayang kulit*" to be more attractive.

I. ACKNOWLEDGE

I would like to take this opportunity to UTeM especially CRIM who give me opportunity for helping me in this project, my wife, and friends, and others in supporting this research

REFERENCES

- [1] P. Matusky, Malaysian Shadow Play and Music: Continuity of an Oral Tradition Oxford University Press, (1993)
- [2] N. Edward, Javanese Wayang Kulit: An Introduction: Oxford University Press (1980).
- [3] J. Salij, Shadow Play and other Stories: Heinemann Singapore (1982).
- [4] B. Osnes, The Shadow Puppet Theatre Of Malaysia: A Study Of Wayang Kulit With Performance Script And Puppet Design. McFarland (2010)
- [5] Mohd Ghouse Nasaruddin. Wayang Kulit Dalam Era Globalisasi, Wayang Dalam Bayang. USM, Malaysia, (2001)
- [6] T. K. Lam, A. Z. H. Talib, and M. A. Osman Real-Time, Visual Simulation and Interactive Animation of Shadow Play Puppets Using OpenGL. International Journal of Computer and Information Engineering 4:1 2010 pg 52
- [7] W. A. Widjajanto, M. Lund, H. Schelhowe, Wayang Authoring: A Web-based AuthoringTool for Visual Storytelling for Children, Proceedings of MoMM 2008 pg 4
- [8] L. A. Liikkanen, G. Jacucci, E. Huvio, T. Laitinen, E. Andre. Exploring Emotions and Multimodality in Digitally Augmented Puppeteering, Proceedings Of The Working Conference On Advanced Visual Interfaces 2008 pg 339-342

- [9] F. Lu, F. Tian, Y. Jiang, X. Cao, W. Luo, G. Li, X. Zhang, G. Dai, and H. Wang, ShadowStory: Creative and Collaborative Digital Storytelling Inspired by Cultural Heritage. Proceedings of Conference on Human Factors in Computing Systems. 2011
- [10] ARToolKit website: www.hitl.washington.edu/art



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