

# Design and Development of an Interactive Virtual Shadow Puppet Play

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**Abstract.** Shadow puppet play has been a popular traditional storytelling method for many centuries in many parts of Asia. This paper describes a method to model a virtual shadow puppet play using sophisticated computer graphics techniques available in Adobe Flash in order to allow interactive play in real-time environment as well as producing realistic animation. Areal-time method is proposed to produce the shadow image that allows interactive play of the virtual shadow puppets by using texture mapping and blending techniques. Special effects such as lighting and blurring effects for virtual shadow puppet play environment are also proposed. Moreover, the use of geometric transformations and hierarchical modeling facilitates interaction among the different parts of the puppet during animation. In essence, our methods and techniques have overcome various limitations of the existing works in virtual shadow puppet play.

**Keywords:** Animation, Blending, Interactive Play, Real-Time, Shadow Puppet Play, Visual Simulation, Virtual Storytelling.

## 1 Introduction

Storytelling tradition has been in existence in almost in every culture and society of the world since ancient times. It has been used as a platform for educate the masses and inculcating morals and values to the audience. One of the well-known traditional storytelling traditions in most of Asia is the shadow puppet play theater [1]-[5]. This storytelling tradition as in other well-known traditional storytelling mainly consists of narrations, songs, and accompanied by a musical orchestra and obviously a set of puppets.

Various advances in digital storytelling and virtual storytelling have been reported in the past notably Papous [6], Virtual Storyteller [7]-[8] and CONFUCIUS [9]. Besides, there was an attempt to adapt interactive storytelling in a mixed reality system [10].

The art of shadow puppet play is slowly becoming less popular in many countries due to the proliferation of modern digital media entertainment and the lack of interest in the younger generation. Therefore, promoting and providing greater accessibility of this masterpiece using modern technologies such as digital media are needed. Although extensive research works have been carried out in the broader area of virtual or digital storytelling, there was only a handful of research efforts in the area of virtual or digital shadow puppet play such as the development of a framework for the traditional shadow play [11], virtual 'wayang' using 'IRIS Showcase' [12], shadow rendering of Chinese Shadow Play [13], and motion planning algorithm for Chinese Shadow Play [14]. Most of the work involved off-line and non-interactive generation of shadow puppet play. Therefore, in this paper, a method of modeling shadow puppet play is proposed using sophisticated computer graphics techniques available in Adobe Flash that will ensure realistic, fast and interactive play in real-time environment.

## 2 Related Works

The virtual storyteller Papous [6] can narrate stories in an expressive manner like a real human storyteller. In this system, the scene tags as well as the illumination tags can be changed directly according to the environment. It has some limitations that include flexibility in expressing the emotions and the limited number of available animations for bodily expression. Virtual Storyteller [7]-[8] is an embodied speaking agent that represents the character as semi-autonomous intelligent agent and also incorporates the narrative and the presentation levels as intelligent agents rather than text-based story generation system. However, the knowledge bases are still limited. In CONFUCIUS [9], a story is presented by creating human character animation from natural language using Humanoid Animation (H-Anim) and MPEG 4 SHNC for the animation. Collision detection, autonomy, multiple-character synchronization and coordination are also included. An interactive storytelling that uses a mixed reality system by putting the user as one of the roles in virtual storytelling has also been attempted [10].

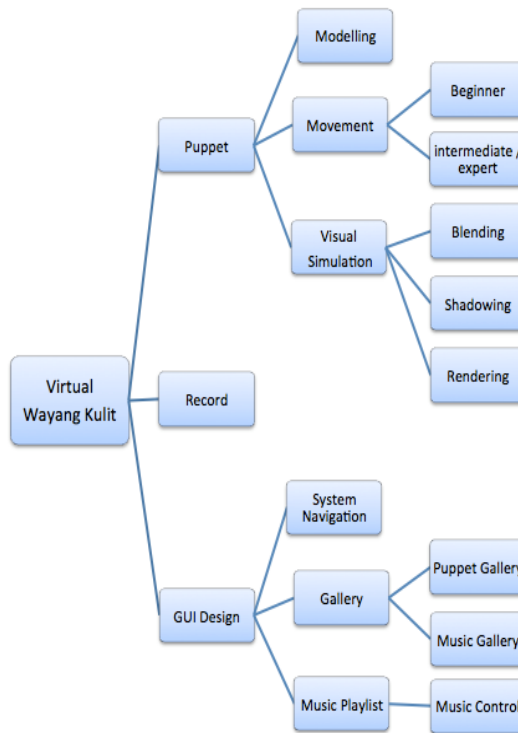
In the area of virtual shadow puppet play, a practical framework for mapping the elements of the traditional shadow puppet play as a virtual storyteller was proposed by Chee and Talib [11]. In virtual 'wayang' [12], realistic puppets were created but during animation, the arms and legs of the puppet do not swing. Zhu et al. [13] used photon mapping to render the shadow puppet. Since the rendering has to be done off-line frame-by-frame (key-frames), real-time and interactive play is not possible. However, good shadow effect, blurring effect, animation and illumination are produced. In Hsu et al. [14], motions of the shadow puppet are generated automatically using motion planning technique and RRT-Connect algorithm is used to incorporate motion patterns for the upper body of the puppet. A post-processing procedure is also required to generate the secondary motions in order to ensure that the lower body complies with gravity and obstacles.

The existing works on digital shadow play in the large do not allow interactive play where the user is required to predefine the frames offline and later a commercial

software system generates in-between frames for the final play. Therefore, in this paper we propose a virtual shadow puppet play application that allows interaction and real-time play of shadow puppet play by developing new techniques for real-time generation of shadow puppet images and interactive animation of the puppets.

### 3 System Overview

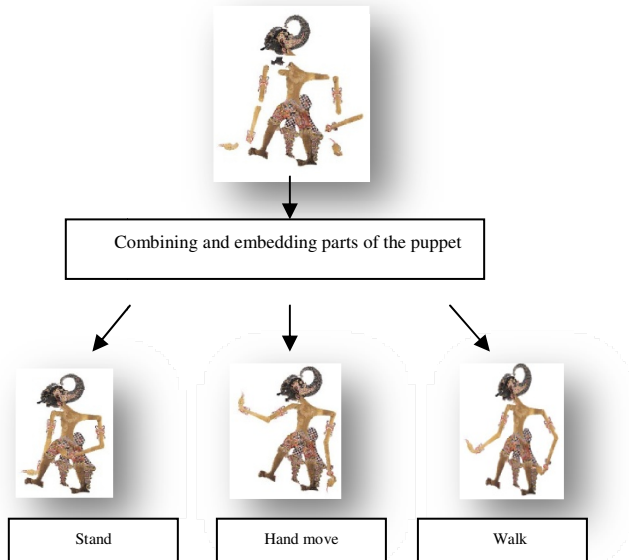
The overall design of our shadow puppet play system consists of three main elements namely Puppet, Record, and GUI Design as shown in Figure 1. The system enables user to animate the puppet and provides a proper environment and appropriate music that will accompany the play.



**Fig. 1.** The Overall Design

The Puppet module consists of Modeling, Movement and Visual Simulation sub-modules. The Modeling sub-module is the place where all the images are stored. In the module, firstly, images with high resolution are imported to the library. Then, the image of the puppet needs to be broken down into smaller parts as shown in Figure 2. The puppet is broken down into pieces based on specific main body parts. All these

parts will be combined in various ways to provide three different types of movement namely Stand, Hand Move and Walk as shown in Figure 2. The Movement sub-module of the Puppet module controls the movement of the puppets and this sub-module provides two different environments for two different categories of users namely Beginner and Intermediate/Expert for novice users and intermediate/expert users respectively. Visual Simulation is the sub-module that touches up the visual simulation after the process of rendering. Blending effect is applied so that the puppet becomes more natural when the brightness of the screen is high. Blurring and shadowing are also required to make the virtual shadow puppets more alive.



**Fig. 2.** Puppet Movements

The Record module is the module that allows the shows to be recorded and replay. The recorded file will be saved in the avi format or swf format depending on the user's preference.

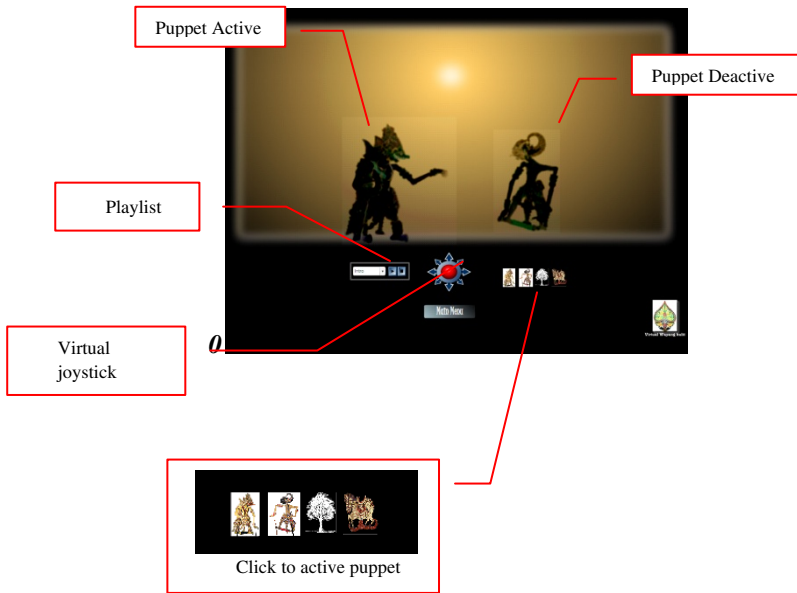
The GUI Design module consists of System Navigation, Gallery and Music Playlist sub-modules. The System Navigation sub-module is the main menu of the application where the user can interact with the system. The menu can be added into XML and only three menus can be displayed at a time. The Gallery stores the name of the puppet and music files. XML is used to store the name of the puppets. XML will be loaded and the image of the puppets will be displayed dynamically. Music Playlist plays the music during the show.

## 4 Implementation

The Virtual Shadow Puppet Play application consists of 8 main scenes. From the first main menu, three choices are provided to the user namely Home, Instruction and User

Level. The Home menu directs the user to the page where all the possible movements of the puppets are displayed. The Instruction menu provides the user manual of this application. Lastly, the User Level menu provides the choice to the user to indicate their level of expertise namely the beginner, intermediate and expert levels.

For the beginner, the user proceeds to play the show without having to choose any music and puppet from the library as shown in Figure 3. The beginner level is suitable for school children or other users who are unfamiliar with the application. This setting provides a virtual joystick to control the puppet movement. The virtual joystick is controlled by an optical mouse. The virtual joystick provides four basic directions namely up, down, left and right. Each direction represents different types of movement.

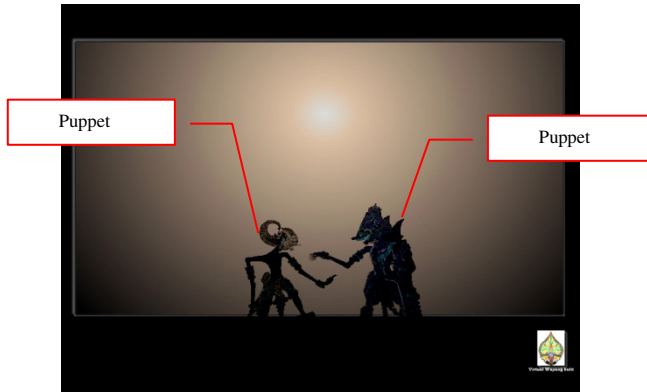


**Fig. 3.** Beginner Level

The intermediate level provides a slightly different interface. The user needs to choose the puppets from the Puppet Gallery and the music from the Music Gallery. With this level, the show will be accompanied by the traditional music and the user will be able to control the music. Besides, a brightness controller is also provided to allow the adjustment of the brightness. The users can also control the movement of the puppet from the keyboard. All the actions are pre-defined and stored in the short cut key. The expert level provides a better appearance of the stage and the user can choose the puppet immediately as shown in Figure 4. Every puppet is assigned its own unique key for the play. The same goes to the music and brightness of the screen.

Blending effect is added to the puppets based on the brightness of the screen. When the brightness of the screen is high, the blending of the puppet becomes more natural

(back to original blending type). Nine types of blending effect can be assigned to the puppet. For example, in the subtract mode, the puppet changes in appearance as shown Figure 5. When the subtract mode of the puppet and the background (screen) has a radial type of the color, the color will be produced according to the brightness of the background (screen).



**Fig. 4.** Expert Stage



**Fig. 5.** Puppet with Subtract Mode Blending

Blurring effect to the puppet is also applied during the fading in and out of the puppet. The code for fading in is as follows:

```
if (puppetIn._alpha<100)
    puppetIn._alpha += (100-puppetIn._alpha)*.25;
    myBlure.blurX += (0-myBlure.blurX)/10;
    myBlure.blurY += (0-myBlure.blurY)/10;
    puppetIn.filters = [myBlure];
}
```

The code for fading out is as follows:

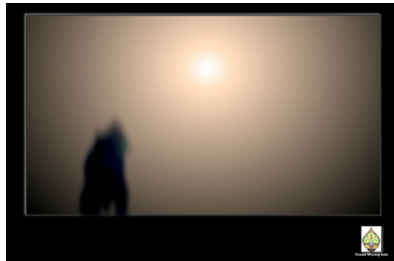
```
if (puppetOut._alpha>0) {
    puppetOut._alpha += (0-puppetOut._alpha)*.25;
```

```

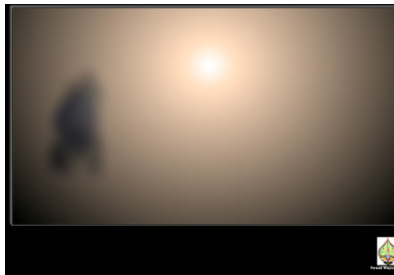
puppetOut._x+= ((myWidth/1.5)-puppetOut._width)*.5;
puppetOut._y+= (myHeight/1.5-puppetOut._height)*.5;
myBlure.blurX += (100-myBlure.blurX)/10;
myBlure.blurY += (100-myBlure.blurY)/10;
puppetOut.filters = [myBlure];
}

```

Figure 6 shows the blurring and shadowing effects during fading in (entering the stage). The effects make the show look more real and reflect the traditional shadow puppet play. Figure 7 shows the blurring and shadowing effects during fading out from the stage. After applying the effect, the movie clip will be removed from the stage when the alpha value = 0.



**Fig. 6.** Blurring and Shadowing Effects on the Puppet During Fading Into the Stage



**Fig. 7.** Blurring and Shadowing Effects on the Puppet During Fading out from the Stage

## 5 Discussion

The shadow puppet in [12] can be moved anywhere but the arm of the puppet cannot be moved or animated. In our work, we can generate the same effect like in [12]. However, additionally, we provide realistic, interactive and real time animation that also includes animation of the arms of the puppets. The time taken to render the puppet in [13] does not allow real time and interactive play. The animator (or player) needs to render offline several key frames and use commercial software to generate in-between frames in order to provide a play for a specific storyline. In our work,

flexibility and interactive real-time capability are provided without having to preprocess key frames and generating in-betweens. A mechanism that allows the arms of the puppet to swing naturally while the character is walking is provided by [14]. In our work, similar types of movement onto the wrist of the virtual shadow puppet have been successfully implemented. This method is also applicable to other parts of the body of the puppet, thus producing a better effect in expression and body languages. However, in [14] some movements can be made at the same time such as the puppet could swing the hand while running. In traditional shadow puppet play of South-east Asia, the upper part of the body of the puppet always remains static. As such, this functionality is not really necessary and not considered in our work. Furthermore, for the lower part of the puppet, they have to adopt a post processing approach so that the legs can swing like a pendulum and comply with the silhouette of the environments. In our work, there is no such necessity for us to go through the same predetermined step. In [14], an attempt is made to create a shadow play animation with a key-framed based approach. However in our work, realistic and interactive motions can be generated and reusability of different types of motions in real time using just hierarchical modeling is made possible. Since the play can be performed in real-time, user is also able to play interactively and change the storyline at any point during the play.

## 6 Conclusion and Future Work

In this work, we have provided several solutions for visual simulation and animation of virtual shadow puppet play. Firstly, texture mapping and blending techniques are used instead of rendering technique in order to allow fast and interactive display in real time environment. Besides, several techniques that use various themes (lighting and brightness) and special effects such as blurring to bring the right atmosphere to the virtual shadow play are proposed. Hierarchical modeling method is adopted in order to model a realistic animation for the puppet to include real time elements that allow playing of shadow puppet play naturally in virtual environment. Previous works on shadow puppet play are not interactive and require manual pre-ordering of the play using key-framed approach.

For future work, we will be looking at special devices for the application such as haptic device and developing an intelligent instructional tool for puppeteering that will be used to guide the user in performing the show.

## References

1. Matusky, P.: Malaysian Shadow Play and Music: Continuity of an Oral Tradition. Oxford University Press (1993)
2. Edward, V.N.: Javanese WayangKulit: An Introduction. Oxford University Press (1980)
3. Salij, H.J.: Shadow Play and other Stories. Heinemann Singapore (1982)
4. Liu, J.: Chinese Shadow Puppet Plays. Morning Glory Publishers (1998)
5. David, C.: Shadow Puppets & Shadow Play. Crowood Press (2008)



6. Silva, A., Vala, M., Paiva, A.C.R.: Papous: The Virtual Storyteller. In: de Antonio, A., Aylett, R.S., Ballin, D. (eds.) IVA 2001. LNCS (LNAI), vol. 2190, pp. 171–180. Springer, Heidelberg (2001)
7. Theune, M., Faas, S., Nijholt, A., Heylen, D.: The Virtual Storyteller. ACM SIGGROUP Bulletin 23(2), 20–21 (2002)
8. Theune, M., Faas, S., Nijholt, A., Heylen, D.: The Virtual Storyteller: Story Creation by Intelligent Agents. In: Proc. Technologies for Interactive Digital Storytelling and Entertainment, pp. 204–215 (2003)
9. Ma, H., McKeivitt, P.: Building Character Animation for Intelligent Storytelling with the H-Anim Standard. In: Proc. of Eurographics Ireland, pp. 9–15 (2003)
10. Cavazza, M., Martin, O., Charles, F., Mead, S.J., Marichal, X.: Users Acting in Mixed Reality Interactive Storytelling. In: Balet, O., Subsol, G., Torguet, P. (eds.) ICVS 2003. LNCS, vol. 2897, pp. 189–197. Springer, Heidelberg (2003)
11. Chee, J., Talib, A.Z.: A Framework for Virtual Storytelling Using Traditional Shadow Play. In: Proc. International Conference on Computing and Informatics (ICOICI 2006) (CD Proc.) (2006)
12. Rahman, K.A.: Wayang “Virtual” Integration of Computer Media in Traditional WayangKulit (Shadow Play) Performance, World Wide Web (1999), <http://www.itaucultural.org.br/invencao/papers/Rahman.html> (accessed February 9, 2008)
13. Zhu, Y.B., Lee, C.J., Shen, I.F., Ma, K.L., Stoppel, A.: A New Form of Traditional Art: Visual Simulation of Chinese Shadow Play. In: International Conference on Computer Graphics and Interactive Techniques Sketches and Applications, p. 1 (2003)
14. Hwu, W.S., Ye, T.: Planning Character Motions for Shadow Play Animations. In: Proc. of International Conference on Computer Animation and Social Agents (CASA 2005), pp. 184–190 (2005)