

Digital Puppetry: Comparative Visual Studies between Javanese & Malaysian Art

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Abstract

Shadow play theatre is one of the most ancient forms of all traditional theatres in Malaysia and Indonesia. There is perhaps no greater symbol or semiotics more specifically, the Kelantanese and Javanese ethos than its classical shadow play (wayang kulit siam and wayang kulit purwa, whose the spiritual roots be submerged into the island's unwritten past and which lies at the core of its immensely rich traditional culture. Unfortunately, they are so unique that they are slowly being extinct and forgotten especially among the young generation of today. Digital puppets are animated metaphors that augment online film entertainment and education content. The aim of the research is to explore the design of digital 3D puppet animation method and augment the rich tacit knowledge embodied in the context of puppet design and movement shadow play theatre. This research paper describes the design puppet related to wayang Siam and wayang Java in terms of design (craft), and movement. We also describe our design approach and the methodology employed in design key studies framed around the concepts 3D puppet animation pipeline. At end of this research, we hope by designing a prototype 3D puppet model and describing digital puppetry as an emerging promising field of application intended for shadow play entertainment, it will provide alternative to explore more in new media entertainment in relationship with the two most unique performing arts entertainment in the world.

Keywords : Shadow play theatre, Wayang Siam, Javanese Puppet, 3D puppet, shadow play, animation, digital puppetry.

INTRODUCTION

Javanese & Malaysia Wayang Kulit combines leather shadow puppets, narration, humour and music to create a highly entertaining performance that lasts several hours. Wayang is the general word applied to many kinds of traditional theatre such as in Java and Malaysia. The word "Wayang" can be described as (wayang) performance, (wayang) puppet or (wayang) character (Jan Mrazek,2005). Shadow play theatre in Indonesia traditionally, has been performed almost always as a ritual, for instance to celebrate a circumcision, a birth, or a wedding (Yosep Bambang Margono, S. Contemporary et. al, 2003). In Malaysia, Wayang Kulit Melayu and Wayang Kulit Purwa are influenced by the Javanese wayang culture and style. Wayang kulit Siam or known as Wayang Kulit Kelantan is a product of Malay villages and most popular type of wayang kulit in state of Kelantan, Malaysia. The shadow play

puppet play in Kelantan is performed primarily as a form entertainment in the towns and villages, for many people, and in the evening's a diversion from the routine daily life (Patricia Matusky,1997). But unfortunately, the Wayang Kulit Kelantan in Malaysia is threatened with forthcoming extinction. According to Amin Sweeney's it was one time literally widespread and popular in Kelantan which research in the late 1960's confirmed the existence of more than 300 *Dalangs* (shadow puppeteer and narrator) (Amin Sweeney,1974). However, the number decreased to 37 in 1982 and 11 in 1999

As for wayang kulit java, changes are needed in order to safeguard this heritage from extinct. According to Ki Sawa (2002) for instance, stated that people of Java are worried that someday, in the near future, the Javanese wayang kulit will be merely a performance and an entertainment that it will lose the values it has been carrying for centuries if changes are not being done. Rather the changes are a matter of survival, because wayang kulit has to compete with foreign cultural products that keep coming to Indonesia in general and to Java in particular. If wayang kulit remains to be performed in the old fashioned way, in the near future it will be neglected by most of the young generation of Javanese (Kisawa, Wisnu et.al Won Poenvono,2002). An interview with Prof Nasaruddin Ghouse from University Science Malaysia in 2010 suggested that in order to survive in the era of *digital natives* and globalization, Wayang Kulit needs a new appearance, to be digitalized into the new media and to be watched on the TV, Cinema, computer or mobile screen by bringing both style and characters to life (Wayang Siam and Java) and making them totally realistic (Mohd Ghouse Nasaruddin, 2001). According to Celine (2010) describe the term animation of digital objects or a digital puppet does incite imagination of audience in a particular way. Audience interacting with such digital "beings" enter also a fictional space. Digital objects can be animated in many different ways and can be transformed in real time to provide novel possibilities for engagement and co-creation (Stefano, et al., 2010)

Therefore this paper describes the visual styles of Wayang Kulit Kelantan & Javanese Wayang Kulit focusing on the two major fundamentals, the puppets design and movement. Our research aim is to explore the related contexts of digital puppetry, real-time modeling and animation, performance systems and the technological interfaces to such phenomena related particularly to Wayang Kulit Siam & Javanese Wayang Kulit. We evaluate and construct puppet/object

theatre performances that use original 3D software systems that are designed to explore 'performance expressivity', with reference to relevant historical, art, entertainment and technological precedents.

RELATED WORK

Shu Wei Shu & Tsai Yen Li(2005) used Chinese shadow play animation as an example to demonstrate that primary and secondary motions shadow play animation system at SIGGRAPH 2005 that utilizes motion planning algorithms developed in Robotics to generate shadow play animations automatically according to user's high-level input scan be considered in the same planning system for creating character animation. The type of system will make high-level specification of character motions easier. With the goal of requiring as fewer key-frame specifications as possible in mind, the systems were able to adopt two mechanisms to automatically generate the desired secondary motions for a character in the shadow play animation (Shu-Wei Hsu & Tsai-Yen Li, 2005). In year 2003, During Festival Film Animation Indonesia 2003 at Jakarta, famous leading experimental short filmmaker Gotot Prakosa, claimed that some World-class experts in animation admitted that the culture of animation was inspired by Wayang Kulit. Furthermore, Wayang Kulit can be seen as the origin of animation and Walt Disney learnt from Wayang Kulit before he made animation (Compas, et al. 2009). He also gave example of Lotte Reiniger's animation which showed distinctive Wayang Kulit influences from Indonesian and Chinese Wayang Kulit.

Ian Grant in 2007 designed a prototype musical performance called of Minnie the Moocher and Me. The machine for performance system were prepared using Apple's Quartz Composer that explores screen based digital puppetry and scenography, hybrid 'mixed reality' video composites real-time vocalisation and synchronised speech and grounding for a new style of hybrid-video digital puppet performance including developing the software programming that enabled wireless Bluetooth control of an on-screen avatar with a popular game controller (Ian Grant,2005). He experimented real-time flame effect can be de-saturated by allowing a careful use of colour within the largely monochrome environment. Currently the silhouette subtly moves, but is not articulated. The 2D shadow-graph shadow puppet theatre looks are flexible and allows simple perspective and depth effects to work. Using film shot of Lotte Reiniger's *The Adventures of Prince Achmed* (1926) and Ian were able to refine the control system and expand the visual repertoire from the film used.

In year, Lotte Reiniger , a German animator created the first feature film called "The Adventures of Prince Achmed" using the visual styles of Wayang Kulit as shown in Fig. 5. It was made using the silhouette technique she invented. Reiniger manipulated cut-outs animation technique made from cardboard and thin sheets of lead under the camera to create an Arabian Nights world of delicate, filigree backgrounds and intricately jointed figures. The technique she used for the camera is similar to Wayang Kulit (though hers were animated frame by frame, not manipulated in live action).

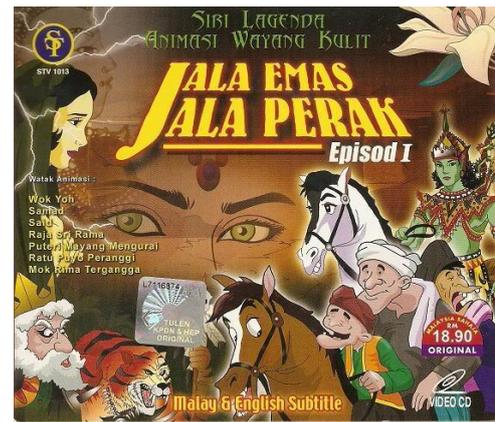


Figure 6. *Jala Emas Jala Perak*, Malaysia First 2D animated Wayang Kulit (Shadow Play)

Khor & Yuen(2009) quoted that according to Prof. John A. Lent who is a Professor of Communications in Temple University, Philadelphia and the author of *Animation in Asia and the Pacific 2009*, there is very limited animation in Asia and uses the visual styles of Wayang Kulit. Art Media Studios, a graphic and animation studio based in Kota Bahru, Kelantan developed the first 2D animated series titled "Jala Emas Jala Perak" (Fig 6.) in 2008 adapted from the original screenplay Wayang Kulit Siam theatre. Characters such Wok Yah, Samad, Said, Seri Rama with new additional characters has given wayang puppetry or shadow play in Malaysia a new approach in modern entertainment. Puppet characters that we watch on screen(shadow play theatre) now is being animated with gesture, expressivity, music, lip-sync(voice-over) and colourful scenery and characters and others that will help to capture the youth especially to watch wayang kulit. However it only captured the narration (voiceover) recorded from *Dalang* (puppeteer) Saupi and the story which was originated from Ramayana epic in Wayang Kulit Kelantan. The overall animation lacked the visual aesthetic of Wayang.

Some attempts have been done on the use of modern technology on digital puppetry related Wayang Kulit play Tan, Abdullah Zawawi and Mohd. Azam(2008) described a method of modeling a Wayang Kulit 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 novel 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 was developed (Tan, Abdullah,Zawawi and Azam, 2008). In 1996, under University Malaysia Sarawak, a research project known as 'Wayang Virtual' was established as an experimental version of the traditional Wayang Kulit from the technological perspectives. The 'virtual' version of the traditional puppet or 'shadow' are combined together with a 3D animated figure and controlled by the *Dalang*(puppeteer) using a mouse on a SGI machine where the visuals were projected onto a white screen. Although the model or puppet

looks “polygon’ type but this project has successfully combined arts and multimedia technology. It was presented to the public at the National Art Gallery, Kuala Lumpur in 1997.

In digitizing shadow plat theatre, Wahyu, Michael and Heidi(2009) presented a multimedia authoring application to support media literacy for children using Javanese shadow play. [19] The children are able to compose a story using Javanese digital puppetry, saving and sharing it. Using AJAX, JavaScript and XML allows the applications to provide rich client-side interface with drag and drop, simple cut out images were design. The application looks simple in terms of layout, story, multimedia rudiments and puppets concept used, but it creates interesting features for children to learn and play through storytelling using shadow play puppets. There are many efforts has being done to develop visual styles for wayang puppetry particularly in Malaysia and Indonesia, but in terms of 3D visualization (digital puppetry) has not being completely especially related to Wayang Kulit Siam & Javanese. Next we will discuss on the animation pipeline designed to develop our 3D model and animation. Firstly, the author started the evocative studies on the visual styles of Wayang Kulit Siam & Wayang Kulit Java by discussing on the two major elements, which are the puppet design and puppet movement in shadow play perspective.

PUPPET DESIGN

A. Puppet Design

Wayang Kulit Siam is a collection of traditions in the local interpretation of the Indian Ramayana epic. A basic Wayang Kulit Kelantan set consists of 65 – 120 puppets representing the principal characters from the Ramayana epic [9]. Evidence for the antiquity of the Javanese shadow play has already been cited with influence of Balinese near-realistic may represent the style and play in Wayang Java. Shadow play In Javanese wayang kulit, each *Dalang* (puppeteer) has at least one set of puppets that comprise between eighty to one hundred and thirty puppets [10]. A complete complement of puppet are divided into ten groups such as *dewa-dewa* (demigods), *satria*(warriors), *raksasa*(jins&gnomes), *orang betapa* (hermit), *monyet*(monkey), *Kayon* and *haiwan*(animals) and each character has its own identity. In Javanese shadow puppet, Islam forbids the depiction of the human form which is one of the reasons given for the highly stylized appearance of Javanese puppets compared to their counterparts elsewhere in South East Asia. The workmanship is also perhaps more refined than most, with very intricate perforations. The best look like exquisite filigree. These puppets come in all shapes and sizes from the squares brutish forms of the giants, ‘*raksasa*’, to the smaller fine limbed figures representing highly cultured kings and nobles. Some are grotesques. In fact every part of a puppet’s design has symbolic significance. Different shaped eyes and noses denote such qualities as nobility, patience, crudeness, steadfastness, strength, loyalty, clownishness or wisdom. There are about 25 varieties of headdress to represent priests, princes, fighters, queen’s deities, kings or gods. Both in Wayang Siam & Javanese the puppets are carved out of cleaned and dried cow skin.

Most of the figures are carved with faces in profile, with the body positioned directly frontal and both the feet pointing in the same direction. Refined or coarse figures are identifiable apart from their bulk, from details such nose, eyes, mouth shapes and sizes, the length of their fingernails and their stances (Ghulam-Sarwar ,2007), They are dissimilar in size; the shorter ones stand about six to nine inches in height while taller one can be up to 36 inches high.



Figure 1. Shows the puppet design Sita Dewi & Seri Rama in Wayang Kulit Siam

According to Khor & Yuen(2006), typically, the figure of noble or refine characters such as heroes and heroines (Seri Rama, Laksamana, Sita Dewi, Sirat Maharaja etc.) are slim and tall while those of the rougher or coarser characters such as the villain Rawana, Bhota and the ogre characters are large and bulky (Ghulam-Sarwar). According to Prof Ghulam Sarwar(2007), the wayang kulit Javanese puppet design are highly stylized and crafted to express character (refer Fig 4.) Each style of puppet in Javanese are referred as *gem-like beauty* in which gold leaf is used only for best puppets (such as *Baladew* or *Arjuna*) describing it as an epitome but this quality is not appreciated in these puppets alone: rather it is present to a lesser degree in any puppet which include carving (or pronounced as *Bedhahan* in Javanese), the colouring and also quality of the colours. The other quality essential to the puppet is uncanny which refers to the realism or puppet look alive. In Wayang Kulit Siam colour symbolism is used within the puppet design, and the face and body colour is prescribed for some of the major characters, although symbolism in the use of given colours is not expressed by the *Dalang* (puppeteer) who design the puppets. This especially in the case of noble characters such as Seri Rama is always painted in green; Laksamana pink or orange; Sirat Maharaja is yellow while Hanuman is white. These colours are derived from Hindu religious symbolism (Khor & Yuen,2009). The principal noble characters are carved so that they stand upon a boat-or-dragon-shaped “vehicle”. The ogres are generally painted with red faces based on a belief derived from the Holy Quran, that giants or ogres (jinn) have their genesis in fire. Apart from their size or volume, refined or coarse characters are identifiable from the shapes and sizes of their nose and mouth, eye, the length of their fingernails and their overall stances.

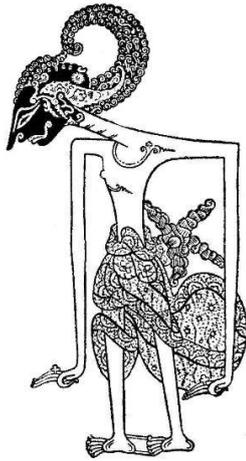


Figure 2. Javanese puppet character Raden Arjuna represents the highly crafted and stylized design in Wayang Java

As confirmed by A Seno-Sastroamidjojo(1964), apart from the eye and the and the face, the puppet anatomy (*anatominya wayang* or *kapangan*), the shape of the puppet (consist details of craft and colouring), he agreed that the face and the eye is influential in Javanese shadow play(Sastroamidjojo et al. 1964) The eye gives the puppet the feeling of life, facial expression or facial disposition of the puppet. The puppets in Javanese Wayang Kulit also can be categorized as good and evil character. For example, all puppets representing *Janaka* symbolize good are designed will be revealed looking down and are small size. Else, evil character are shown having huge nose and also head facing up symbolizing arrogant.

The *Pohon Beringin* in Wayang Kulit Siam representing the tree of life, in the Malay shadow play is comparable to the mountain (Gunungan or Kayon) in Javanese wayang kulit purwa (Claire, et al. Holt,1967). *Pohon Beringin* always appears at the beginning and end of a performance, and in the context of a story or repertoire it may be used to indicate cosmology elements such as wind, fire, fire, water and other phenomena exist in the natural world. According to Patricia Matusky (1997), like the Javanese *Gunungan* or *Kayon*, in the Malay cosmology tradition the *Banyan Tree* also encapsulates the essence of the existing in wayang puppetry, thus reflecting the all phenomena and objects in the natural world. The quality in design, anatomy and cosmology representation both wayang provides life to the puppets and thus the quality of dream like strangeness, and defines the inner nature of the represented character as well the concept of communication between human, god and nature in a typical shadow play theatre.

B. Puppet Movement

A narrow piece of split wood is attached to the length of the body and a smaller bamboo is attached to one arm as a handle for articulating movement. However, comic puppet characters such as Pak Dogol and Wak Long have both articulated arms,

and some have movable legs, jaws and eyebrows. The figures are perforated in order for the designs of jewellery and other details become manifest when light is placed behind them. Both feet of each character point in the same direction. Comic figures have both arms articulated this being an apparent Javanese influence in puppet design. Most Wayang Kulit Kelantan characters have a single articulated arm mainly for the main figures such as Seri Rama and Sita Dewi (Fig 3.). A lamp (*pelita*) hangs at the middle of the screen(*kelir*) at eye-level height with the *Dalang*(puppeteer) sits on the floor manipulates the puppets between the lamp and the screen casting the shadow on the screen as he relates a tale.



Figure 3. Seri Rama(right) and Sita Dewi(left) have single articulated arm in Wayang Kulit Kelantan

In the context of Javanese Wayang Kulit, different individual puppets, depending on their functionality and individual character are design and shaped by the performance in different ways. Example, the puppet *Janaka* (Fig 4.) have moveable arms and its important case of puppets often appear in fighting scenes, the manipulation and the arms are most complicated. Jan Mrazek (2005) define this technique called *gendiran* is a clean execution used in *Janaka* character which the *Dalang* (puppeteer) shows the skill of manipulating using technique called *tuding* (the stick with the arm controlled) is hit one or two fingers (of the hand that holds the puppet) in such a way moving up and moving around a circle as shown in Fig 4.

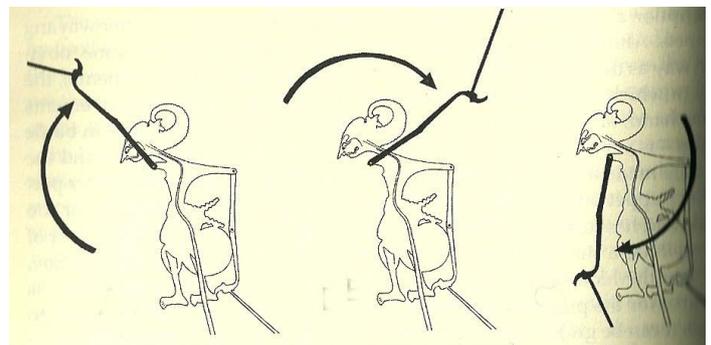


Figure 4. Shows *Janaka* puppet is manipulate using a technique called *tuding* in Wayang Kulit Javanese

Most puppets in Javanese wayang kulit have two moveable arms, but some puppets have only the front arm moveable which quite similar to wayang kulit Siam, while the rear arm like *Begawan Durma* (arm is lame) while carved such puppet *Jambumangli*, a ogre have either one or two arms. But many puppeteers prefer to ogre puppet with only one moveable arm due to they are more describe as *penak* (pleasant or comfortable).

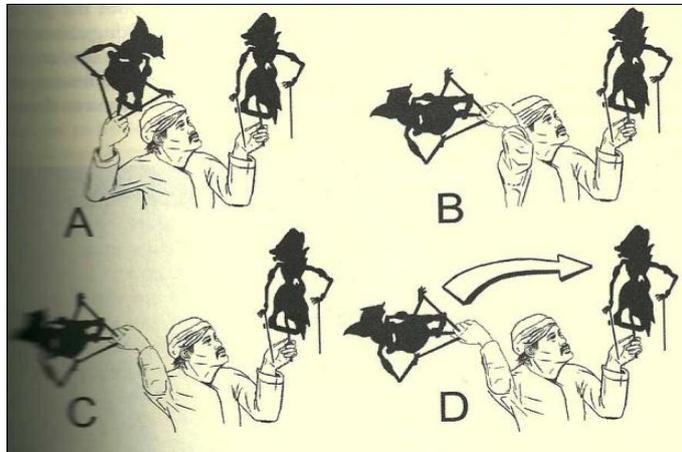


Figure 5. Shows the physical blow movement puppetry by Stephen Salel

The physical blow in Javanese Wayang Kulit described by Stephen Salel related to what happens to the puppet when it is moved in performance. The puppet ‘stands’ it is placed more or less vertically on the screen (Fig 5. A) shows process for the blow, the whole puppet is moved backward quite like one would move a hammer or axe before it strikes (Fig 5.B). At the farthest point of the movement, the puppet is about horizontal, or even the puppet’s head can be below the level of its feet (Fig 5.C). Then, to represent the blow, the puppet is thrust from that position at the other puppet similar if the puppeteer were thing a hammer (Fig.5 D), the particular part of the puppet that is hitting (such as the puppet hand) is aimed at the particular part of the puppet that is to be hit (such as chest or head). Finally, the hitting movement representing the blow is both forceful and controlled. The movement in Wayang Siam & Wayang Java are similarity of the puppet to be represented being so slight or remote that is unidentifiable. Certain puppets are portrayed with meaning through action, movement, special effect of fire or lamps, speeches and delivered in a normal human voice while the puppet is motionless. Wayang can be different from the actors’s theatre in that the character is not represented merely by the performer’s body, but depiction by the puppet.

ANIMATION PIPELINE

The 3D animation puppetry model for Wayang Kulit Siam and Javanese wayang puppetry is divided into two modules; a puppet modeling and a puppet animation. From a user’s perspective the first step in creating an animation is to construct the cast of physical 3D puppets. Here, we will experiment with 2 characters which is *Seri Rama* from

Wayang Siam and *Raden Arjuna* from Javanese Wayang. Later, we will develop the animation for both digital puppetry using 3D Studio Max. Then as the user manipulates the puppets to perform a basic movement with some virtual lighting and camera and renders them into an animation in real-time.

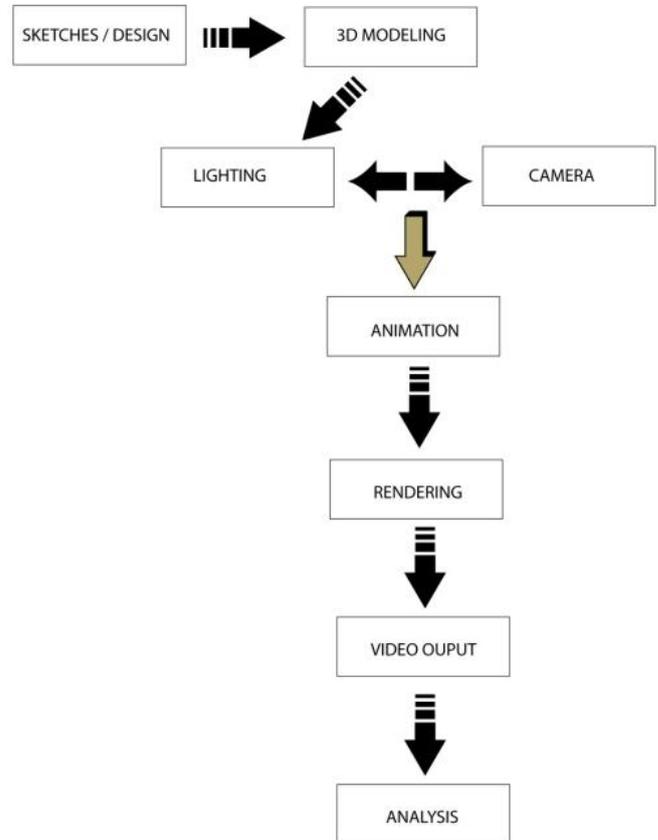


Figure 7. The Quasi-linear nature of 3D Modeling & Animation Process

In Fig 7. shows a chart of the quasi linear nature of the developing 3D modeling and animation process. According to Adam Watkins, Michangelo had volumes and volumes of sketches and it’s important to develop designs, layout, and also the reason they were able to create excellent pieces of artwork based on the reactions to what they just laid on canvas (Adam Watkins,2001). Firstly, we design sketches based on the two puppet characters (*Seri Rama* and *Raden Arjuna*) in order for us to study the form and shape of anatomy, objects, or craft. Sketches such as comprehensive, thumbnails, and layout were placed for the animator to visualize the puppet personality and form provides a valuable visual resource during tedious hours of modeling. in virtual world. In 3D animation there is no different, the aspect of how the 3D puppet model will be laid together to form cohesive image and reflection on colour and lighting is essential.

Next is modeling process. Modeling is creating 3D objects in a 3D environment. A computer model is the same; it is a collection of digital instruction interpreted by the computer to form the geometrical appearance. In every 3D software

application, it is common to understand the Euclidean Geometry Model depicts X as horizontal; Y as vertical and Z are 0. In modeling transformation, a puppet can be considered as an object that consists of hand, wrist, leg, gesture and other components which can be specified in terms of second-level components. We used Polygon and Splines NURBS (Non Uniform Resource B-Spline) to design Seri Rama and Raden Arjuna articulated 3D puppet model. Polygon models are the least taxing on computer's processing muscles. The polygon creates face that exists between three or more edges. It has been proven those polygon models are used in a variety applications such as animation television, high end medical simulation, military simulation and others (Tom Capizzi, 2002). In order to combine polygonal models, we used 3D polymesh that grouped together to form one puppet solid object.

Example, Seri Rama (refer Fig 7.) the 3D model would appear ultra-realistic with movement and flexibility using polymesh. We used .obj file to preview the inner workings of a polygonal model including the amount vertices and faces contain in the file. The sample below describes all the vertices in order of the creation:

```
V 0.000000 -0.707107 -.0707107
V -0.707107 -0.707107 -0.000000
V 0.000000 -0.707107 -.0707107
V 0.707107 -0.707107 -0.000000
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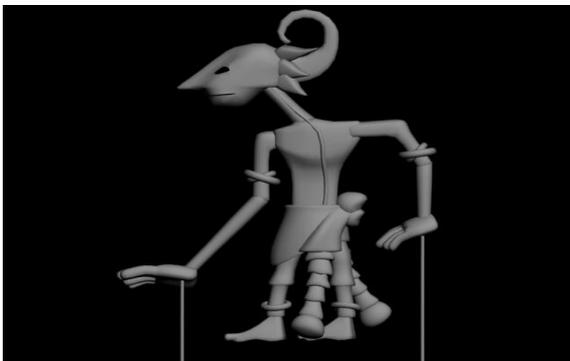


Figure 8. Smooth shader 3D model containing vertex values

The number listed represents each vertex X, Y and Z in values for each vertex and indicates their identity. The amount used in Seri Rama model (Fig 8.) is relevant including coincident vertices and edges were also deleted to avoid duplicating edges, vertices or faces damaged the modeling process. Splines is another approach to define the sequence of three-dimensional vertices that connected by lines. We use splines in Seri Rama & Raden Arjuna 3D model to model the head, body which is much easier due to splines has straight lines and the beauty of these splines-based curves is that not contain any sharp corners. Example, the character 3D model Raden Arjuna (Refer Fig 9.) even though the original 2D puppet is much more complicated, but using splines it allows us to lathe and extrude the lines to create a three-dimensional shapes.

Another form of spline we used is NURBS or Non Uniform Resource B-Spline which contains control points (vertices) that offset from the actual interpolation lines. The amount of polygon count is minimal for both 3D puppet models in order to control number and control of vertices. This is important especially when it comes to rendering that allows each frame to be rendered fast and maintained the quality. Many 3D designs and modeling systems build on non-uniform rational B-splines (NURBS) and the programs require users to move "control points" that only roughly correspond to the shape of the model's surface (Thomas Massie, 1998). NURBS curves are even more effective and ubiquitous in the world of computer animation.



Figure 8. Raden Inu 3D model puppet with complicated crafts

According to Adam Watkins(2001), without lighting system, animations cease to be a visual art form. In 3D animation, consist of four different types of light source such as: ambient, global lights, point lights and spot lights. Shadow play entertainment is important that light and shadow must be coherent, and in order for our 3D model to achieve the same mood and characteristic in virtual environment, we used ambient and spot light for the 3D puppet model. Using ambient helps us to emulate the bounce that occurs with all lights. With ambient light it makes the entire scene brighter without affecting the shadow even though lacks of control over any sort of selective focus. We also experimented we spot light which it provides ultimate control of everything from brightness to direction to colour and volumetric effects. The spotlights were able to create the source, direction, and full-intensity radius, fall-off and fall-off distance as shown in Fig 10.



Figure 10. Spot Light used in Seri Rama puppet 3D model

Basic tenant of design is the composition or camera view. The careful placement of key element that assist communication and aesthetic beauty in virtual shadow play theatre. Here, in our research we used some fundamentals shot such as long shot (LS) which instantly orients the audience to the immensity of this scene and grabs the attention. Even though, the 3D puppetry animation that we designed does not include story, but it is important for us and the viewers to appreciate the sense of film or camera shot in our research. We also used Medium Shot (MS) camera in MAYA 3D software to provide viewers the vital piece of information how the puppet will move, gesture they are using, gestures are intended, facial expression and also as a way to keep the audience oriented.

Puppet character animation concerns the association of human or puppet behaviour with an animated character whether it is a human, puppet or creature. Our main problem bringing puppet animation to life with amazing realism. Hand and body gestures, body posture, puppet movement characteristic are all included to add that extra level of realism. A basic tenant of animation is that movement is simply a sequence of different images that when shown in rapid succession provides the illusion of movement. The term computer animation is thus the core technology involving computer and moving pictures (Magenat-Thalman, et al.D Thalman,1985). Key frame animation is one type of the frame-based animation since it uses the knowledge of shadow play puppet manipulation to design animation procedures. A simple motion can be divided into multiple phases surrounded by key frames with distinct spatial constraints in each phase. Then the motion between key frames is computed by appropriate interpolation functions satisfying the temporal or spatial constraints both Seri Rama and Raden Arjuna 3D model. Animations produced by this approach have the advantages of being flexible and computationally efficient for 3D real-time environments. Nevertheless, it is also a great challenge to design a procedure with appropriate parameters that can produce reasonable motions. In procedural animation, different motions require different animation generators. This is important due to both Wayang Kulit characters has their own style of movement such as Seri Rama include single articulated arms, in Raden Arjuna has both arms articulated this being an apparent Javanese influence in puppet design The process of an animation procedure is carried out by following three steps. First, the motions performed by a master puppeteer are recorded and the motion parameters are extracted to describe the characteristics of the motion. Take hand for example, the motion (key frame) parameters include hand length, hand movement, and some timing information.

Second, the motion is disintegrating into several phases by defining key frames to separate these phases according to the above motion parameters. Lastly, the procedure for interpolation between the key frames is defined. Key frame can were used to describe how the hand, body and head might move around in a scene during an animation sequence or simply to view them from another angle. Next, using Hierarchical geometry is a classifying object by dividing to two groups. To animate in the first group we simply apply series of transforms to the object's coordinate. But in the second group we are able to identify every individual part of

the object that moves relative to the object, as well as the entire object. For example, when we animated Seri Rama hand, we need to move an individual finger without moving the other fingers, but when we move the complete hand, all the fingers move together, or otherwise the hand will have no geometric integrity. Therefore, to support such animation we construct our objects with geometric hierarchy. By creating hierarchy of geometry it is possible to isolate individual elements, and groups as well as the entire structure, not only for puppet animation, also lip sync, eyes, facial expression and others also. Key frame animation used to describe how the 3D puppet hand, leg and wrist might move around in a scene during an animation sequence or simply to view them from another angle.

Key frame animation always allows us to specify the animation speed between a pair of key frames. Example, by animating Raden Arjuna 3D model hand, we can move linearly (equal time steps), accelerate way from one key frame and decelerate into the next key frame (non-linear steps) or known as ease-in ease out in a traditional animation style. Transformation process involved scale, translation and rotation is also needed to animate the Seri Rama puppet 3D model. Even though puppet animation in 3D can be very frustrating, as it is not possible to model and animate everything to the level of realism and in a realistic time scale. The next process is known as rendering, which rendered final images are integrated with video. In our research, we render different elements (.TGA) files separately in order to manipulate individually at the compositing or post production process. Each .TGA or *Targa* files consists 256 levels of transparency and forms known as *alpha channel*. The alpha channel is a normal feature in any digital image consists of three layers primary colour data and one layer of transparency which are available in Seri Rama and Raden Arjuna 3D model image. Each image will be able to compute the amount of background colour. Example, Seri Rama & Raden Arjuna 3D model puppets are animated across the virtual white plane or screen, and a shadow is used to integrate it with the scene. If the 3D puppet were rendered together with the shadow and an appropriate *matte*, it could be that the shadow is discovered to be too light or dark when composited. Even using *matte*, we had to render everything again and redo the process of compositing scenes using Adobe After Effects software.

Thus, if the both 3D puppets and shadow are rendered separately with their individual matted, the other individual elements are able to be manipulate to obtain quality output. We also used Ray-tracing in our rendering to simulates, the behaviour of light source in virtual world. Ray Tracing engine enables to create reflection, and also reveals the casting shadow, transparency and refraction through the virtual white plane both 3D puppet characters designed. Rendering the Raden Arjuna 3D model needs more softened with the ray tracing function due to the detail amount of polygons and geometric used. During the rendering of our experiment, we also tried using Depth of field (DOF) virtual camera in our rendering software that created an effective touch of realism. We were able to set a focal point where Ser Rama and Raden Arjuna characters are at the front that the focal point which the audience able to see but are out of focus. Overall, during

the rendering process, there were several factors that we identify four our rendering engine such as the amount of polygon, light source within a scene, special characteristic like Ray-tracing, depth of field, size file and others. Once our 3D puppet model has been animated, next we determine the video file format. One way to save our animations is to save them in a sequential file or still image. The animation for both characters is estimated to be 60 seconds long (1800 frames) and therefore our render batch output will be Seri Rama001.tga to Seri Rama 002.tga. Using software such as Adobe After Effects allows the experiment output the file formats of .AVI or QuickTime. The benefit using movie format is it can be destined for several media such television broadcast, internet (YouTube or face book), DVD or even cinemas screens.

EVALUATION

The population of the study consisted of the final year bachelor computer animation (BCA) students of University Kuala Lumpur. The choice of the bachelor computer animation was to ensure that the field of knowledge between traditional and digital puppetry can be discuss further. The total number of animation students in the course was sixty. The university is one of the leading and its preference was informed by the availability of computer animation and rendering facilities that could assist animation or digital puppetry experiment. The animation lab is also well equipped with 3D Studio Max and MAYA 3D software, including high end post production facilities. Some of the students of the university are also designers and programmers. They could use during production and post production soft ware's in animation. The sample of the study consisted of seventy five students that were randomly selected using systematic random sampling technique. The number was randomly assigned to two groups namely on modeling and animation for 3D puppet Seri Rama and Raden Arjuna Javanese wayang puppet respectively. The experimental groups were engaged in observing the animation the two 3D puppet characters in addition to the conventional digital puppetry. The first experimental group view the Seri Rama and Raden Arjuna traditional and digital puppetry especially both on 3D modeling and animation in computer laboratory one after the other after each session. The preference of the computer animation class was to ensure that the modeling and animation experiment meets the minimal requirement in a traditional wayang puppet or shadow play theatre. One instrument were used for data collection in order to evaluate the effectiveness and the efficiency (real-time elements) of the proposed approach for puppet modeling (shadow image), and animation of the puppet. The first was structured a questionnaire has been designed to obtain feedback on 3D modeling and animation. They were prepared with accompanied marking scheme that awards one point mark throughout the questions. The second was experimental one minute animation of Seri Rama and Raden Arjuna Javanese wayang kulit digital puppetry that can be viewed on desktop screen. A "panel of expert" on animation technique was employed in establishing the content and assemble validity of the instrument. This involved subjecting the instruments to industrial by experts (

from Les Copaque and Red Turtle local animation studios), two academics in animation, and two fans of wayang kulit puppetry related to the field that the instruments examined. They agreed that the question items covered the objectives of the research and were good. Each individual (student) were required 5 - 10 min interactivity session to view both traditional and 3D visualization of Seri Rama & Raden Arjuna wayang puppetry animation on the desktop computer especially on the modeling and animation.

RESULTS

Table 1 shows that there was no difference among the means of the three categories on pre-testing. Any observed differences thereafter could reasonably be attributed to the behaviour. Table 2 shows the post-test mean score of group one is the highest, meaning that the students exposed to 2D traditional wayang kulit (shadow play) after watching are still preferable compared to 3D visualization overall. The superiority of the group that used 2D visualizations was confirmed by the information presented on Table 3.

Table 1. Pre Test Mean performance of students viewing 3D & Traditional *Wayang Kulit*.

Content	Mean Score	No of Students
Traditional Style	20.62	20
3D Visualization <i>Seri Rama</i> (WKS)	18.75	20
3D Visualization <i>Raden Arjuna</i> (JWK)	21-53	20

Table 2. Post Test Mean performance of students viewing 3D & Traditional *Wayang Kulit*.

Content	Mean Score	No of Students
Traditional Style	64	20
3D Visualization <i>Seri Rama</i> (WKS)	55.4	20
3D Visualization <i>Raden Arjuna</i> (JWK)	41.45	20

Many of the respondents think that the Seri Rama and Raden Arjuna 3D model virtual puppet modeling is rather compatible to the traditional ones. Seri Rama crafting of the outline of the puppets has properly shadowed the real puppet compared to Raden Arjuna character which too craftily and does not appear similar to the traditional manner. On the animation, most of the respondents have rated a standard rating. The movements of the arms are not so flexible. One thing in common about Seri Rama and Raden Arjuna 3D puppet model is the respondents also feels that the arms could not swing freely in

a recurring movement. Seri Rama single articulated hand was much easier for the respondent to accept compared to Raden Arjuna to which the respondent feels the movement does not reflect the original movement in a Javanese wayang kulit. A few respondents commented that, if inveterate movements could be applied successfully onto the wrist of the puppet, we could also apply the same method on the arms to produce the inveterate movements. Some respondents even suggest including more lighting effect and camera shot as well. Many respondents showed their agreements and were fascinated by the differences that can be completed to the shadow theatre language as similar to a film style. This is due to one distinct similarity that can be found between the theme for the traditional shadow play and our theme in virtual shadow play. Some respondents suggested further enhancement of the visual effects, music, new stories, and augmented technology with 3D visualization would be effective especially by combining Wayang Kulit Kelantan & Javanese into one theatre scene.

FINDINGS & DISCUSSION

The results of this study show a significant difference in the performance of students within the 3D visualization of Seri Rama and Raden Arjuna also the conventional styles of wayang kulit(shadow play theatre) and the traditional method is still the preferable choice of entertainment compared to 3D puppetry style. In the experimental, Seri Rama modeling and animation looks much more effective compared to Raden Arjuna character and also making use of 2D visualization shadow theatre performed significantly better than those making use of 3D visualization. However, scores of students in both 3D visualization puppet models were close and even though the traditional method was much higher than those in 3D visualization.

Table 3. Summary of ANOVA: comparison of means (Pre-Post)

Source Variation	Sum Squares	Mean Value	Degree Freedom	F-Value	Critical F- at 0.05
Treatment	1645.3	7985	3	14.67	4.5
Within Error	812	49.7	67	-	-

This shows that the uses of 3D visualizations enhanced performance in traditional puppetry and are thus better digital entertainment. The shadow play puppet in [24] can be animated in form of X,Y and Z axis compared to traditional puppet play which can only be animated in X and Y axis providing depth and volume for puppet to move and viewed. But the certain body component such as the arm of Seri Rama and Raden Arjuna puppet cannot be moved or animated. In our work, we are able to generate the same effect that was done by K.A Rahman (1999) by developing wayang virtual. Additionally, we provide basic modeling and real time animation that also includes animation of the arm and body of the puppets. The time taken to do rendering of the both 3D

puppets as computers takes up memory and sometimes does not provide detail real time and interactive play (. Zhu, Lee, Shen, L. Ma, et al. Stompel,2003) The animator needs to render offline several key frames especially for Javanese Raden Arjuna 3D puppet character due to amount of polygon geometric involved. In our research, flexibility and real time capability are provided without having to pre-process key frames plus generating in-betweens.

Method that allows the arms of the puppet to swing naturally while the character is walking is provided by (W. S. Hwu, T. Ye, 2006). In our experiment, similar types of movement onto the wrist of the virtual shadow play's puppet for both Seri Rama and Raden Arjuna have been successfully implemented. This method is also applicable to other parts of the body of the puppet, thus producing a better effect of puppet 'expressivity' and body languages. The difference is that in some movements can be made at the same time such that the puppet could swing the hand while running. However, in Malaysian shadow play, for example Seri Rama upper part of the body of the puppet always remains stagnant. Therefore this particular approach is not into much consideration in our work.

In our experiment, we also compared briefly the advantages of using 3D visualization compared to traditional shadow play theatre. 3D animation or visualization provides a rich collection of tools that aid the process of modeling and animation. 3D visualization provides from a wide variety of modelling techniques based on user requirement. Lighting and camera setup is the exact replica of a real world movie shooting environment or shadow play theatre. Apart from all these, the ultra realism offered by the 3D rendered scenes makes 3D graphics the best solution for the emerging animation industry. With improvements in real-time computer graphics machines and 3D software, digital puppetry has become a viable tool in character animation (David J. Sturman, 1998). Currently, digital puppetry is restricted to those who can afford large machines and expensive motion capture equipment. As machines get cheaper and faster, digital puppetry systems will become widely available, just as computer animation is today. Digital puppetry is an important form of motion expression that allows animation directors to view character's performance/talent in real time and make immediate corrections to achieve the desired result However, technology comprises just one important aspect in this medium. As in any art, the final product's success depends on good puppetry, acting, design, and directing talent.

Furthermore, Raden Arjuna lower part of the puppet model, we have to adopt a post processing approach so that the legs can swing similar to a pendulum and comply with the silhouette of the environments. Somehow, in our work there is no such necessity for us to go through the same predetermined step. However in this experiment, 3D modeling and real time motions in MAYA can be generated and the reusability of different types of motions in 3D real time software using just hierarchical modeling is made possible. As it allows viewing in real time, each change on the modelling, animation, lighting, camera of the shadow play could be changed and corrected on the spot without further dithering. As three-

dimensional synthetic imagery is used more and widely in contemporary visual culture, our approaches and techniques are acceptable for visual 3D modeling and animation of shadow play's puppet that allows real-time animation of virtual shadow play as metaphor for both countries to safeguard and expand the valuable cultural masterpiece to the world.

CONCLUSION

In this work, we have provided in-depth studies on 2 cultural of wayang kulit provided in 3D visual modeling and animation of virtual shadow play's puppet. Firstly, animation pipeline including modeling and animation for Seri Rama and Raden Arjuna 3D puppet character are analyzed in order to allow fast and effective display in real time environment. Previous works in the context of shadow theatre are not real-time or immersive and require manual pre-ordering of the play using key-framed approach. For Indonesia and Malaysia, the shadow play theatre is a bridge that connects two multi-cultural countries that will be helped preserved this performing arts from extinct. For future work, a general baseline that creates the augmented reality, 3D Television, digital comics based on shadow play theatre will provide more realistic environment for real time shadow play. Furthermore, a more realistic animation for real time animation shadow play can be achieved using 3D application techniques including motion capture and other digital puppetry devices.

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