

## New Shadow Modeling Approach Of *Wayang Kulit*

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### **Abstract**

*Javanese puppet that is also called wayang is one of traditional culture from Java beside traditional music and traditional dance. There are 8 types of wayang in Indonesia such as wayang beber, wayang purwa, wayang madya, etc. In this case, we focus on wayang purwa especially for wayang kulit. There are 223 pieces of wayang kulit for one set. The art of wayang kulit is not only from the real form, but also from the shadow of the puppet. It can be more artistic depending on the motive of small holes on the wayang kulit form. This paper presented a new shadow modeling approach from the real puppet form. We called Color Selective method, which uses image processing especially in color processing concept to get the shadow of the wayang kulit. The method will separate the wayang kulit image and its background which it takes 10% of image height and width from four corners of the image. This paper gives a result that color selective method as a new shadow modeling can be applied to get approach of wayang kulit's shadow model, where wayang kulit image is as the input. As the result, color selective method about 90% same as the input image.*

**Keywords:** *wayang kulit, shadow modeling, Color Selective method, color processing*

### **1. Introduction**

Javanese puppet that is also called *wayang* is one of traditional culture from Java beside traditional music and traditional dance. There are 8 types of *wayang* in Java such as *wayang beber*, *wayang purwa*, *wayang madya*, etc.. *Wayang purwa* has many forms such as *wayang golek*, *wayang kulit*, and *wayang wong (orang)* [1]. In this case, we focus to *wayang kulit* that originally came from Java. There are 223 pieces of *wayang kulit* for one set. There are many factors which make *wayang kulit* become interesting to everyone especially for the Javanese. The factors are music, visual design, movement, and powerful storytelling [2]. One of the visual design is the shadow of the puppet as well as the real form. Thus, it is called *wayang* that in bahasa means *bayangan* or in English means shadow [1]. Shadow puppetry is the play of the visible and the invisible. The light, both in its quality of radiance and in its location or position, is vitally important. Shadow cannot exist without the light [3]. Therefore, the shadow simulation of Javanese puppet is interesting to develop.

The purpose of this research is to present a new shadow modeling approach which called color selective method. The Process of color selective method uses image processing concept. Image processing concept is used in varieties of applications in many of areas such as medical, biology, security, geology, and arts [4, 5]. The process in the image processing has many stages. The image processing stage consists of identifying the image regions or pixels [6]. Color processing is one of the main process in the image processing. In color image process system, two implementation methods are considered. The First is color separation by pixels, and another one is color separation by units. The former method is to assign the red, green, and blue channels to the individual pixels, and the latter is to assign these color channels to

the individual units [7, 8]. Beside the two implementation methods above, color features of images can be represented by color histograms. These are easy to compute, and are invariant to the rotation and translation of image content [9]. This new shadow modeling approach helps people who like Javanese puppet to know the shadow form of the puppet with image of puppet as the input.

## 2. Wayang

*Wayang* is a culture which came from Java. In bahasa, *wayang* means *bayangan*. In the past, the function of *wayang* show is as the religion ceremony as a worship of ancestors of *Hyang* faiths which is an indigenous Indonesian culture. As the time passing by the function of *wayang* grew up to be used for social communication media which has benefits for supporting community development. *Wayang* play story is a representation about nature and character of human in the world that reflects the nature and character of a typical human, so that many people are affected by the appearance of the characters [1].

*Wayang* can divide into 8 types which consists of several varieties, there are :

### 1. Wayang Beber

*Wayang Beber* is the oldest form of *wayang*. This *wayang* is described in the roll of paper where in the scroll contains events or important scenes in the story. The show is done by reading story and show images that have been described.

### 2. Wayang Purwa

*Wayang purwa* has the form of *wayang kulit*, *wayang golek*, or *wayang wong* (human). The story of this *wayang* was lifted from *Mahabaratha* or *Ramayana* book.

### 3. Wayang Madya

This *wayang* described from the central body to the top has the shape of *wayang purwa*, while from the central body to the bottom has the shape of *wayang gedog*. *Wayang madya* uses a dagger made from leather, inlaid and decorate.

### 4. Wayang Gedog

*Wayang gedog* art form is made from leather that is inlaid with harmonious decoration which takes archetype of *wayang kulit purwa*.

### 5. Wayang Menak

On the show of *wayang menak*, we can find 2 types of *wayang menak* form, they are *wayang golek* dan *wayang kulit* form. Overall *wayang kulit menak* form can be said to be similar to *wayang purwa*, only face of this *wayang* nearly similar to face of human. The figures in this *wayang* uses shoes and sling *klewang*, while the figures of the king wearing clothes and dagger.

### 6. Wayang Babad

The story of this *wayang* is taken from history after the introduction of Islam in Indonesia. For example: the story about heroism in the kingdom of *Demak* and *Pajang*.

### 7. Wayang Modern

#### 8. *Wayang Topeng*

This *wayang* is shown by a dancer who use the mask that created similar to *wayang purwa* with own customized which be adapted with mask name where the mask is growing [1].

### 3. Shadow Modeling

Shadows are formed because light travels in straight lines. When an opaque object or material is placed in the path of rays of light, shadows are created. Usually shadow refers to an area without direct light or with weak direct light due to an object blocking light to other objects. Shade refers to light variation caused by change of shape of the object itself. shadows and shade all refer to the darker part in an area. In shadow areas, there is no direct light but only scattered and reflected light [17].

Shadow model should select the features of suspected shadow pixels from all foreground pixels. Shadow modelling can use multi Gaussian function. Using multi Gaussian function for shadow pixels construction, the shadow model will discriminate whether the pixels belong to the shadow pixels. The shadow points often misidentified as the target point. However, the texture feature of shadow area is similar to the background, but it is of great difference between the object and background. Therefore, the combination of texture feature and color feature of pixels will fully distinguish the shadow pixels and object pixels [18].

### 4. Color Image Processing

Image processing concept was used in varieties of applications in many of areas such as medical, biology, security, geology, and arts [4][5]. Input for image processing are images. An image is often represented as a function  $f(x, y)$  or a vector  $f(x, y)$ , where  $x$  and  $y$  represent the spatial coordinates on the image plane, and the value at any location  $(x, y)$  is commonly known as the intensity. In digital images  $x, y$ , and the intensity take only nonnegative integer values [14].

In image processing concept there is one important part to help in identifying objects that is color [10]. Color is often thought as a property of an individual object. The color of object comes from the visible light that reflects at the object surface [9]. The most common color spesification simply uses the red, green, and blue brightness value scaled, for example, between zero and one. This convention is called RGB format. The color of each pixel can be represented by the location of a point in the first quadrant of three dimensional color space (RGB space) [11]. For color image, the vector consist of three individual components corresponding to red, green, and blue (RGB) with values between 0 and 255 for each component [14]. RGB color space is the most common color representation that has been adopted in large amount input/output devices for color information. An RGB color space can be easily understood by thinking of it as all possible colors that can be made from three colour ants for red, green and blue [9].

### 5. Color Selective Method Algorithm

Color selective method is a new method which uses image processing concept especially color processing concept. Each colored image has different Red Green Blue (RGB) value. RGB value in an image is stored in three canals which are red canal, green canal, and blue canal. Colored image is a matrix that consists of three lights primary color with unit 8 type or

integer value whose maximum bit is 8. It means maximum boundary for each red, green or blue color value is 255.

This algorithm has many steps, there are :

Step 1 : read the input image then change it into matrix.

Step 2 : take 10% of image height and width from four corners of the image.

Higher value of this percentage will make the sample become not valid, but it is too small that the sample doesn't really represent the image background. 10% in this case is just 'about value'. It means that it will not really take any different result when use 9%, 11%, 12%.



**Figure 1. Red Box Presented 10% of Image Height and Weight from Four Corners**

Step 3 : from each corners will be taken the most minimum red values, green values, and blue values in which this value represents the darkest color and the maximum red values, green values, and blue values in which this value represents brighter color.

Step 4 : get the average of 3 canal RGB values from four corners with equation 1, 2, 3, and 4.

$$lusumred = (\sum_{i=0}^{m-1} \sum_{j=0}^{n-1} lured(i,j)) / (m \times n) \quad (1)$$

$$lusumgreen = (\sum_{i=0}^{m-1} \sum_{j=0}^{n-1} lugreen(i,j)) / (m \times n) \quad (2)$$

$$lusumblue = (\sum_{i=0}^{m-1} \sum_{j=0}^{n-1} lublue(i,j)) / (m \times n) \quad (3)$$

$$luavg = (lusumred + lusumgreen + lusumblue) / 3 \quad (4)$$

where lusumred= sum of red value in the left-upper corner

lured= value of red color in left-upper matrix corner

m= width of corner matrix

n= height of corner matrix

luavg= average value from total of sum of left-upper corner matrix

There are same functions to get another average value of another corner matrix such as right-upper, left-bottom, and right-bottom corner.

Step 5 : count the average background value with equation of 5

$$avgbg = (luavg + ruavg + lbavg + rbavg)/4 \quad (5)$$

where avgbg=average background value

luavg= average value from total of sum of left-upper corner matrix

ruavg= average value from total of sum of right-upper corner matrix

lbavg= average value from total of sum of left-bottom corner matrix

rbavg= average value from total of sum of right-bottom corner matrix

Step 6 : process of selection of four corners to declare whether that corner is valid for usage or not. Average background value from each corner will be subtracted by minimum value red or green or blue in each corner. If the difference value is smaller than 75, the corner's value won't be used. The difference is presented in equation of 6.

$$diffVal = avgbg - minValue \quad (6)$$

where diffVal=difference value

minValue=minimum value

Step 7 : get minimum and maximum red, green, and blue value from the valid corner.

Step 8 : maintain the color whose RGB value is larger than minimum background values but smaller than maximum background image.

Step 9 : compare between difference maximum value from three RGB values and minimum value from three RGB values in each cell in the image matrix then compare to the value of gray level from the images. Then, RGB value should be more than 127. Because the color below is closed to black so it is not needed to maintain the color. The grey level is the shadow color of the image and noise color of the image whose color is near to grey color. This algorithm assumed that shadow color is closed to the grey color in which red, green, blue values are equal and the value is less than 255 and more than 0. However, in fact the difference between RGB values, about 10, is still grey so this algorithm still gives the tolerance for definition of grey color. The grey level is the value that is inserted by user, as long as the observation of the value can be between 5 and 45. In this case, the noise color is the color of the background image which is different from the background image but human eyes can't differentiate it.

Step 10 : apart from step 7 and 8, the color will be changed to black color.

## 6. Result and Discussion

In this section, we discuss about the shadow modeling result with color selective method. For example, we use image with white background image.



**Figure 2. Input Image Example 1**

The real image size is 300 x 600 pixels, and we take 10%, so the corner matrix becomes 30 x 60 pixels, it fills the m and n value. The smallest red or green or blue values inside the left-upper matrix is 255 which means it's absolutely white and the maximum values is 255. Then, the smallest value inside right-upper matrix is 238 that means it isn't absolutely white but still white in human eyes because the white color is still dominant and the maximum value is 255, the smallest value inside left-bottom matrix is 102 which means there is a really different color inside the matrix and the maximum value is 255, the smallest value inside right-bottom matrix is 205 and it's still bright value so human eyes can't differentiate it and the maximum values is 255. In addition, Average upper-corner matrix value (luavg), a sum of all Red value that is 45900 is divided by 30 x 60 which is 180 that gives a result of 255 added with sum of all Green value that is 45900 which is divided 180 that gives a result of 255 added with sum of all blue value that is 45900 divided with 180 and gives a result is 255 and then divide it all by 3, so the final result is 255. It means that all of the color in this matrix is 255, because it is the highest value. Do the same thing of all matrix corner and we get the result ruavg is 254.6072, lbavg is 252.9359, and rbavg is 254.8694. From that all result, we get the average background color which is

$$avgbg = (255 + 254.6072 + 252.9359 + 254.8694)/4$$

$$avgbg = 254.8694$$

The next step is to select the valid background corner using different value. The different value for each corner will be:

$$\text{Left-upper diffVal} : 254.8694 - 255 = -0.1306$$

$$\text{Right-upper diffVal} : 254.8694 - 238 = 16.8694$$

$$\text{Left-bottom diffVal} : 254.8694 - 102 = 152.8694$$

$$\text{Right-bottom diffVal} : 254.8694 - 205 = 49.8694$$

Considered by that difference values, the left-bottom different value is not valid because it's less than 75, so the valid background value is left-upper, right-upper and right-bottom. There are 3 minimum values and 3 maximum values in the valid background. And the least value is 205 from the right-bottom, and the most value is 255.

The grey value for this picture is 10, because it has very small noise in the picture. How to know the noise is by using experiment, if there is some black color in background result we should reduce the grey color, but if there is some real *wayang* color in the *wayang* shadow in the result we should increase the grey color.

This algorithm will be failed when the color of the *wayang* object is similar to the background. It can happen because this algorithm compares the color between background and *wayang* object. Therefore, this algorithm can see the small holes in the *wayang* motive as background. The output result from Figure 2 is presented in Figure 3.



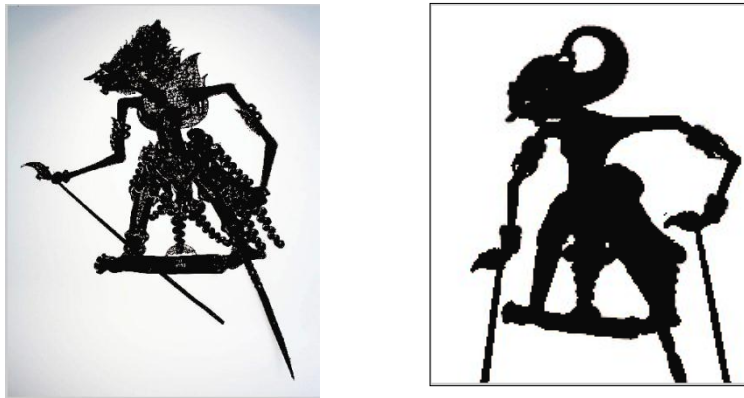
**Figure 3. Output Image Example 1**

We take the other two examples of *wayang* image in Figure 4. The image must be in RGB format (JPEG, JPG, BMP, GIF, TIFF, PNG, etc).



**Figure 4. Input Image Example 2 and 3**

Output for example 2 and 3 is presented in Figure 5. For example 2 and 3, the same calculation is used as example 1 with different value. The right-bottom corner sample background for this two sample is not valid because there are some *wayang* parts crossing that area.



**Figure 5. Output Image Example 2 and 3**

We can see in Figure 5 that the shadow model is nearly closed to the object shadow, majority of all holes is shown in Figure 5. The background color is still not changing but the *wayang* color becomes black. From the example we can see that the reflection of the flash from camera when the picture is taken will be read by this algorithm as holes because the reflection will be represented as high RGB value. Besides, the reflection color is in the range of background maximum and minimum value.

## 7. Conclusion

Based on the results of experiments shadow modeling with color selective methods can be seen that this algorithm is 90% same as the real *wayang* shadow, it's depend on the input image. This algorithm used 10% of the image height and width, and evidently better than values less than 10% or higher than 10%.

This algorithm can't detect grey level automatically, for further research is still need to develop to automate the grey level detection. The development is purposed to get better result more quickly and accurate in shadow modeling.

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