



AI ASSISTED FACIAL RECONSTRUCTION OF PANJI'S LOVER CHARACTER IN PENATARAN TEMPLE'S BAS RELIEFS USING SKETCH TO IMAGE METHOD

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Abstract:

Purpose: Purpose of this research is to realistically reconstruct face of Panji's Lover character at 51st panel of Teras Pendopo structure's bas relief in Penataran Temple complex as guide for concept art creation of Panji's Lover character.

Research methods: This experiment consists of two steps. First is manually drawing a sketch of the character and describing her facial features. The second step is image generation by artificial intelligence employing sketch-to-image method using created sketch as base image and the description as prompt. The used artificial intelligence (AI) program is Stable Diffusion 1.5 with ControlNet add on. The used AI models are Realistic Vision 5.1 and Dreamshaper 8.

Findings: Images generated with Realistic Vision 5.1 model are closest to sketch and description of original bas relief.

Implications: The results of this experiment can't be used as final artwork but can be guide for concept art creation for both *Candra Kirana* and *Galuh Ajeng* character in any future visual art projects based on *Panji Tales* stories.

Keywords: artificial intelligence, Panji Tales, sketch to image, generation, Penataran

INTRODUCTION

Panji Tales has been a popular literature in Southeast Asia since Majapahit era. One evidence of its past popularity are bas relief carvings at several Majapahit era temples that visually tell various Panji stories. according to Kieven, those temples are Penataran Temple, various temple sites on Mount Penanggungan, Rimbi Temple, Mirigambar Temple, Gambyok bas relief, and Panji statue from Grogol [1, pp. 147–156]. From the mentioned temples, Penataran Temple complex contains most Panji Tales visualization from Majapahit era. These bas reliefs can be observed at the wall of Teras Pendopo structure in Peataran Temple complex. This structure was built in 1375 AD, during the reign of king Hayam Wuruk [1, p. 191].

As folktales, Panji Tales are well known from oral tradition. Panji's adventure to find Candrakirana became inspiration for various folktales around Southeast Asia. In Java, folktales titled *Timun Mas*, *Keong Mas*, *Bango Tong-tong*, *Lomaran*, *Ande-ande Lumut*, *Enthit*, etc are Panji's journey stories about him doing a kind of pilgrimage called *namur laku* [2]. Based on Kieven's citation from



Poerbatjaraka, Prince Panji and Princess Candrakirana was depiction of King Kameswara (7th king of Kediri that reigned between 1180-1190) and his queen, Kirana which both are real person [1, p. 191].

The main element of Panji Tales is this following plot: encounter and farewell between Prince Panji/Inu Kertapati and Princess Candrakirana/Sekartaji.

Followed by Panji's journey with his servants during his search for Candrakirana. Panji is involved in several battles. Panji establishes romantic relationship with other women. Panji becomes a bard and musician. Panji becomes ascetic. Finally, Panji and Candrakirana are reunited [3].



Figure 1. Picture card of Ande Ande Lumut
[Source: Joel [4]]

In Indonesia, Panji Tales are adapted in various types of modern media. There are picture cards, illustrated storybooks, animations, dramas, and local pop songs. Generally, visual style of this modern adaptation takes style from traditional arts form of Panji Tales such as *Wayang Orang* opera, and *Gedog* puppet performance. For example, characters' outfit of picture card toy as seen in **Error! Reference source not found.** are similar with *Wayang Orang* opera costumes.

There is also photographic artbook by Rio Wibowo that depicts various scenes from Indonesian folktales. One of them is Ande Ande Lumut, one variant of Panji Stories as seen in **Error! Reference source not found.**



Figure 2. Photograph by Rio Wibowo that depicts scene from Ande Ande Lumut
[Source: Rio Wibowo [5]]

Wibowo depicts characters' outfits with contemporary *Batik* costume.

From various modern artworks that take the stories of Panji Tales, there are rarely those who take visual style from Javanese temples' bas reliefs. Whereas there are many Javanese Temples' bas reliefs that depict scenes from Panji Tales stories. Compared with all Javanese Temples in East Java, *Teras Pendopo* structure in *Penataran Temple* complex has the most depictions of Panji Tales scenes. The challenges for adapting visual style from Javanese Temples are many parts of bas reliefs are damaged by vandalism and natural causes. Many details are missing because of the damage. Despite the damage, there are many carvings of Prince Panji that are still in good condition and his details and facial features are still recognisable, so it is easy to use these carvings as references for adaptations in other media. Unfortunately, this doesn't apply to Princess Candrakirana character. Kieven identifies several female figures as Panji's lovers but does not mention specific names. Almost all female figures' faces are badly damaged, and their facial features can't be recognizable. Only one female figure still has recognizable facial feature with only half of her face still intact. Fortunately, this figure is one of several figures that identified by Kieven as Panji's lover. With only one Panji's lover figure that has recognized facial feature, moreover with only half of her face, it is more difficult to adapt Candrakirana character from *Penataran Temple* to other media.

Re-drawing temple relief figures for adaptation in other media is generally done by imitating or tracing the image on the temple relief into a sketch. The sketch is then used as a reference for further development into various kinds of works of art. The existence of artificial intelligence technology allows existing sketches to be converted into realistic images, including traced sketches from temple reliefs which can help artists obtain clearer reference images.

Stable Diffusion 1.5 is artificial intelligence software that can create images synthetically. In creating images, artificial intelligence cannot immediately create images, but needs to be trained first, or can also use the results of training that has been carried out. The results of this training are called models. In Stable Diffusion, there are two types of models that are commonly used, namely *Checkpoint* as the main model and *LORA* as an additional model to produce more specific parts of the image. Stable Diffusion 1.5 can be used to create realistic images with precise models. This software can create images from *prompts* only or can also be done with sketches and *prompts*. There are other softwares such as DALL-E2 and Midjourney, but in 2022, Stable Diffusion is the best software for producing realistic images [6].

The recognizable Panji's lover face can be made as sketch, then be improved realistically using artificial intelligence. Realistic image generated with this method aims to be used as alternative reference for concept art creation of nonspecific Panji's lover characters in comics, illustrated storybooks, or new media arts such as animations, games, or other audio-visual artworks with Panji Tales themes. The problem of this research is how to experiment with artificial intelligence to generate realistic images to create Panji's lover character images from character in *Penataran Temple*. The result of this research aims to be

alternative references for concept art creation of Panji's lover characters that can be either Candrakirana or Dewi Galuh Ajeng.

RESEARCH METHODS

This realistic image generation experiment was done in the following steps: first was manual tracing. The photograph of Panji's lover figure in *Penataran Temple* was traced to get the sketch of her face. Next step was observing the figure and describing it. The sketch then was prepared as base image, and the description was used as prompt for artificial intelligence image generation.

The artificial intelligence software used was Stable Diffusion 1.5 A1111 (can also be abbreviated as SD 1.5) with the ControlNet add on. Image creation was done using the sketch to image method using the ControlNet add on and then processed by Stable Diffusion. The ControlNet add on was used as a place to input sketches for sketch to image. In fact, there is a built-in SD 1.5 feature for inputting sketches, but from the author's experience the results too often deviate from the input sketch. Using Stable Diffusion alone would produce 1 desired image out of 10 trials [7], therefore ControlNet was used so that Stable Diffusion can be set to assist in prioritizing sketches so that the result can match the input sketch. To process the input sketch and/or prompt, Stable Diffusion requires a checkpoint model as a style reference. The model used in this experiment was Dreamshaper 8 [8] and Realistic Vision 5.1 [9]. ControlNet also needs a model to generate an image as close as possible with inputted sketch. Model used in ControlNet for this experiment is Canny 1.1 [10].

The computer used in this experiment used following specification: Intel Core i5 11400 processor, 16GB of DDR4 RAM configured in dual channel, Nvidia GeForce GTX 1650 4GB OC, and 1TB Gen 4 NVME SSD.

FINDINGS

Panji character and Candrakirana character were inspired from real life characters, King Kameswara II of Kediri and his consort, Queen Kirana from Jenggala. The difference from real life character is in Panji Tales, Prince Panji (which is future King Kameswara II) was a prince of Jenggala instead of Kediri, and Princess Candrakirana was a princess of Kediri instead of Jenggala.

Panji character or Inu Kertapati was identified as capped male figure according Kieven [3]. Kieven did not mention which bas reliefs that depicts Candrakirana, but only identified young female figure that accompanies Panji in romantic scenes as Panji's lover.

From researcher's observation, most bas reliefs that depicts figures of Panji's lover at *Teras Pendopo* structure wall have damaged



Figure 3. Face of Panji's lover figure at 51st panel

[Source: Tegar Andito [11]]



Figure 4. Tracing progress
[Source: Tegar Andito]

faces beyond recognition [11]. The only recognizable face is Panji's lover figure at 51st panel, Story of The Parrot. as seen in Error! Reference source not found..

This Panji's lover figure's face is half damaged but other half that still undamaged has good condition. Right eye, right eyebrow, lips can easily recognizable, moreover, facial expression is also recognizable.

Pose of this character can be described as kneeling, head slightly lowered, with a stunned facial expression, and looks gloomy. Facial features look rounded face, rounded eye, round chin, medium lips, and thick eyebrows. She is also depicted using bun hairstyle. If observed thoroughly, at side of eye looks using eyeliner make up. Worn jewelries are flower shaped head

accessory and necklace with flower shaped pendant. This description was then simplified into following prompt:

young javanese lady, close up, sorrow, golden jewelry, black hair, bun hair, sorrow, looking sad, beautiful, dark skin, flower shaped earrings, looking down left

The facial parts in this figure that still in good condition were manually traced to produce sketch of half face as seen in Error! Reference source not found..

The tracing result was then manually inpainted to add missing parts of the face. Left half of hair, left eye, and eyebrow were added. The added parts of face are mirror of already existing counterparts. After inpainting, cleanup process was performed. During cleanup process, original photograph was reobserved and it was found out that there is flower shaped earring at left ear. Because of this, left earring was added in the sketch.



Figure 5. Tracing result
[Source: Tegar Andito]



Figure 6. Facial sketch of Panji's lover figure.
[Source: Tegar Andito]

This sketch was then inputted into ControlNet and the prompt was inputted into SD 1.5. There were 8 trials that consisted of 5 variations of prompt that was used to employ Dreamshaper 8 and Realistic Vision 5.1 as model.

At first variation (trial 1 and 2), inputted prompt was plainly from description. There was also common negative prompt inputted to prevent bad quality image. Detailed settings can be seen in **Table 1**.

Table 1. First prompt variant

prompt	young javanese lady, close up, sorrow, golden jewelry, black hair, bun hair, sorrow, looking sad, beautiful, dark skin, flower shaped earrings, looking down left
sampler	DPM++ 2S a Karras
cfgs	7
steps	20
negative_prompt	bad anatomy, bad proportions, blurry, cloned face, cropped, deformed, dehydrated, disfigured, duplicate, error, extra arms, extra fingers, extra legs, extra limbs, fused fingers, gross proportions, jpeg artifacts, long neck, low quality, lowres, malformed limbs, missing arms, missing legs, morbid, mutated hands, mutation, mutilated, out of frame, poorly drawn face, poorly drawn hands, signature, text, too many fingers, ugly, username, watermark, worst quality

Entire trials are using same sampler, cfgs (classifier-free guidance scale, a parameter that controls how much the image generation process follows the text prompt [12]), and steps. Same negative prompt was used for trial 1 to 7.



Figure 7. image generated using Dreamshaper 8

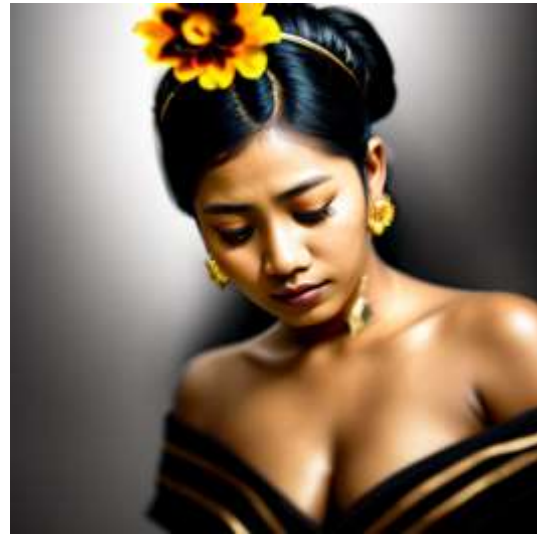


Figure 8. image generated using Realistic Vision 5.1

The first variation is considered to have a thin face with a sharp chin for both models. In the results from experiment 1 of the Dreamshaper 8 model, the faces tend to have East Asian characteristics (**Figure 7**). In experiment 2, namely with the Realistic Vision 5.1 model, the face had the typical characteristics of a Malay woman's face and closed eyes (**Figure 8**).

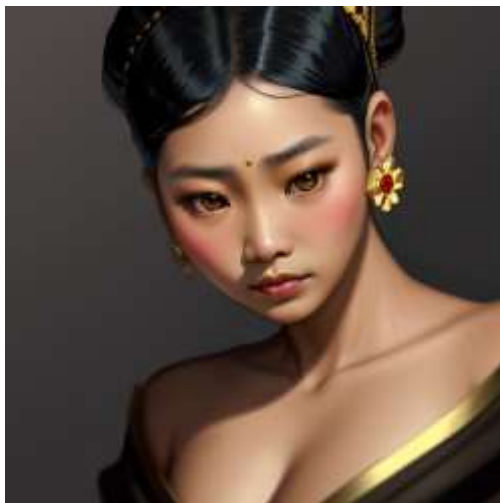


Figure 9. Result of Trial 3

To avoid thin face and sharp chin, the second variant of prompts (trial 3 and 4) was slightly changed into these following keywords:

*young javanese lady, **malay race, round face, round chin, wide lips, black colored eyes, close up, sorrow, golden jewelry, black hair, bun hair, sorrow, looking sad, beautiful, dark skin, flower shaped earrings, looking down***

Trial 3, using Dreamshaper 8 was successfully generated **Error! Reference source not found.** however, trial 4 that used Realistic Vision 5.1 failed to generate

image. This second prompt variant strengthen East Asian features of image generated using Dreamshaper 8. To add ancient feel and improve technical quality of image, the third prompt (trial 5 and 6) are written as follows:

ancient hindu princess, young javanese lady, malay race, round face, indonesian, round chin, wide lips, black colored eyes, close up, sorrow, golden jewelry, black hair, bun hair, sorrow, looking sad, beautiful, dark skin, flower

shaped earrings, looking down, RAW photo, subject, 8k uhd, dslr, soft lighting, high quality, film grain, Fujifilm XT3

Trial of third prompt from Dreamshaper 8 model (trial 5) generated image of female figure with thicker lips, but still has East Asian characteristics. Realistic Vision 5.1 model was failed again generating image. It was found out that Realistic Vision 5.1 with used computer specification can't bear too many keywords to generate image.



Figure 10. Result of Trial 5

At trial 7 (using Dreamshaper 8) this following keywords was being prompted:

ancient javanese princess, young javanese lady, malay race, round face, indonesian, round chin, wide lips, black colored eyes, close up, sad face, golden jewelry, black hair, bun hair, sorrow, looking sad, beautiful, dark skin, flower shaped earrings, looking down, RAW photo, subject, 8k uhd, dslr, soft lighting, high quality, film grain, Fujifilm XT3

Whereas trial 8 which was using Realistic Vision 5.1, the substantial keywords for the prompt are same as trial 7, but some technical keywords were omitted. The negative prompt also completely removed. Trial 8 keywords are:

ancient javanese princess, young javanese lady, malay race, round face, indonesian, round chin, wide lips, black colored eyes, close up, sad face, golden jewelry, black hair, bun hair, sorrow, looking sad, beautiful, dark skin, flower shaped earrings, looking down

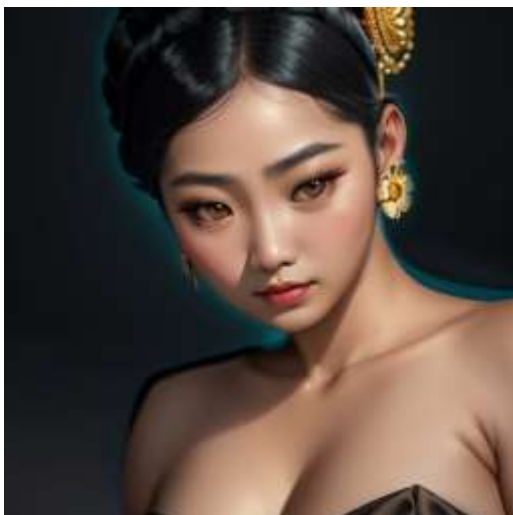


Figure 11. Result of Trial 7



Figure 12. Result of Trial 8

Trial 7 (Error! Reference source not found.) produced a face with similar characteristics to the results of trial 5 but with brown eyes and slightly smiling lips.

Trial 8 (**Error! Reference source not found.**) produced a face similar to the results of experiment 2, but with a slightly thinner face.

If compared with the relief, sketch, and identification of facial features, the best image from the Dreamshaper 8 model is the result of trial 5, while the best image from the Realistic Vision 5.1 model is the result of trial 2. The following are the results of trial 2 and 5 if juxtaposed with reference reliefs and sketches:

Table 2. Comparison between bas relief, sketch, and AI generated image at trial 5

Bas Relief	Sketch	Trial 5 result
		

Table 3. Comparison between bas relief, sketch, and AI generated image at trial 2

Bas Relief	Sketch	Trial 2 result
		

CONCLUSION

In the process of tracing the image of the Panji's lover figure at 51st panel relief of the *Teras Pendopo* structure of Penataran Temple to become a sketch, several facial features were identified. The facial features tend to be round, round eyes, round chin, medium lips and thick eyebrows. Also identified was makeup on the edges of the eyes that looked like eye liner. The head is slightly lowered, with a gloomy facial expression. The results of this identification are then used as a description to be prompted keywords in Stable Diffusion A1111.

Eight experimental trials have been carried out to create realistic images of the Panji's Lover characters using artificial intelligence in this research with 5

variations of prompts and with 2 different models. The keywords in the first variation of the prompt are taken directly from description, while the next prompt mostly contains the same keywords but several additional keywords are added to enhance the generated image. Of the 8 trials, 2 trials failed to produce images, so 6 images were obtained. The 4 images produced by the Dreamshaper 8 model are faces that tend to have East Asian characteristics. From the Dreamshaper 8 model, the result that is closest to the description is the result of trial 5. For the results from the Realistic Vision 5.1 model, the two images that were successfully generated have good conformity with original description. However, in terms of facial shape, the result from trial 2 has the best similarities to the image on the reference relief.

Images resulting from artificial intelligence cannot be used as final artwork but can be used as a reference for creating concept art in designing the Panji's Lover IP characters for animated works, comics or games that highlight the Panji Tales. Making manga or anime style works can use references from the results of trial 1, 3, 5, and 7 whereas if someone want to use a realist style, or Indonesian comic style, it is recommended to use the results of trial 2.

If the story of the Panji Tales contains only Candra Kirana/Dewi Sekartaji as Panji's lover, then one of the results of the experiment can be used as a reference for designing the character Candra Kirana/Dewi Sekartaji. If in the story both Candra Kirana/Dewi Sekartaji and Dewi Galuh Ajeng appear, then one can be used as a reference for designing the character Candra Kirana/Dewi Sekartaji and the other result can be used as a reference for designing the character Dewi Galuh Ajeng because in various versions of the Panji Tales, these two characters are siblings.

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