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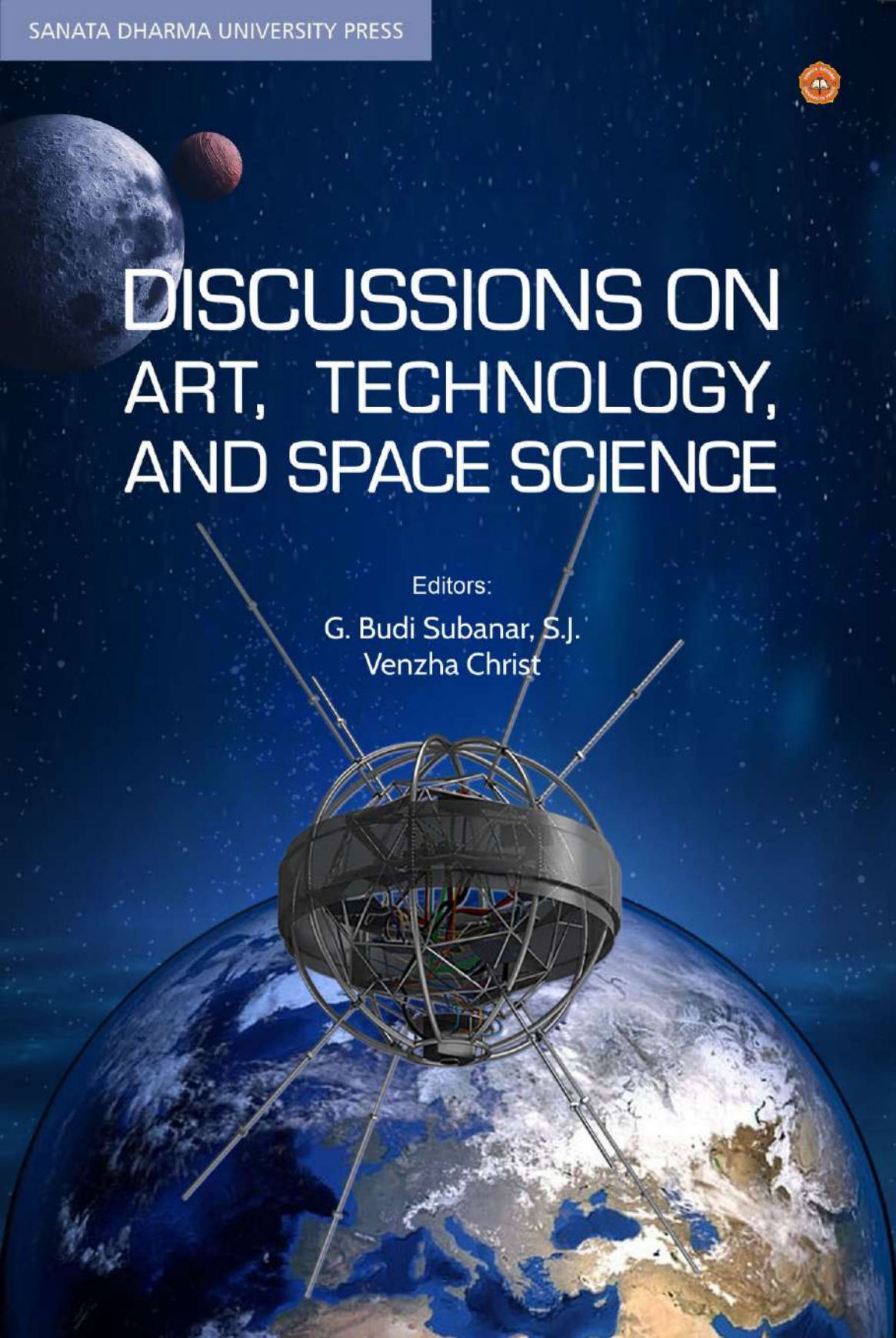
DISCUSSIONS ON ART, TECHNOLOGY, AND SPACE SCIENCE

Editors:
G. Budi Subanar, S.J.
Venzha Christ



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Foreword

This volume presents a curated selection of papers and reflections derived from the INTERNATIONAL S.E.T.I. CONFERENCE 2024 – International Conference on Art, Technology, and Space Science. The conference convened a multidisciplinary assembly of scholars, researchers, and practitioners from across Indonesia and internationally, including representatives from the United States, the Netherlands, Japan, and Singapore.

Participants brought with them a broad spectrum of academic and professional backgrounds - spanning the natural sciences, technological innovation, communication studies, visual and performing arts, cultural studies, and philosophy. This diversity underscores the interdisciplinary ethos of the conference and affirms the necessity of cross-disciplinary dialogue in addressing complex contemporary questions.

In addition to academics and researchers, the conference also welcomed artists and independent scholars, including contributors from the United States, Japan, the Netherlands, Singapore, Mexico, and Germany. Their presence enriched the discourse and expanded the scope of inquiry beyond conventional academic boundaries.

While the overarching framework of the conference was organized around the intersection of art (space), science, and technology, the breadth of contributions reveals a dynamic interplay of perspectives and methodologies. This interdisciplinary structure enabled a robust engagement with the central theme of Search for Extra-Terrestrial Intelligence (SETI), viewed not merely as a scientific pursuit, but also as a cultural and philosophical inquiry.

The proceedings documented in this volume reflect the intellectual vitality and discursive plurality that emerged from this international forum. The event was held through the collaborative efforts of the Doctoral Program in Cultural Studies (Art and Society) at Sanata Dharma University, Yogyakarta, and the Indonesian Space Science Society (ISSS), as part of the Indonesia UFO Festival (IUF) 2024.

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Table of Contents

Digitization Transformation of Ancient Manuscript of Serat Menak with Turtle Graphics Algorithm

Ratnadewi[*], Ariesa Pandanwangi[*], Arleti Mochtar Apin[**]

Introduction

Jayengrana is a major character in the ancient text of *Serat Menak*. Jayengrana or Amir Hamzah or Amir Ambyah or Wong Agung Menak or Wong Agung Jayengrana or Wong Agung Jayang-Resmi, was a figure who spread Islam along his journey. *Serat Menak* tells the conflict between Amir Hamzah, a Muslim, and Prabu Nusyirwan, who is not a Muslim (Zaelani, 2022). Amir Hamzah was believed to have lived a century before the birth of the Prophet Muhammad. He was the Prophet's uncle and led a nomadic life while engaging in struggles (Tashadi et al., 1993). Amir Hamzah was the son of Abdul Muttalib and Siti Fatimah, a nobleman and ruler of Makkah then. Amir Hamzah was an Islamic hero who fought from one kingdom to another to spread Islam. This is what distinguishes between historical and contempory cultural Islam. In this context, cultural Islam refers to the fusion of Islamic teachings with Javanese traditions, which incorporate elements of animism, dynamism, anthropomorphism, and even Hindu-Buddhist influences. Amir Hamzah married Dewi Ratna Munigar or Dewi Ratna Munigarim, the daughter of Prabu Nusyirwan.

Jayengrana was a handsome, dashing, and refined man, with various names, the most common being *Wong Agung Menak*. Arjuna is a character similar to Jayengrana's description, particularly after he has won a war. He always married the daughter of the king he had defeated (Nur & Sumiati, 2018). Jayengrana was such a mighty warrior that no one in his time could

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defeat him. This is what made him a famous figure, as recorded in ancient manuscripts.

R. Ng. Yosodipuro I translated *Serat Menak* into Javanese, and from this translation - which consisted of 48 volumes with 24 plots - it was enjoyed in the form of poetry, prose, *wayang* art, dance (Yulianingsih, 2016), gamelan, musical instruments, and religious elements. The *Serat Menak* is a legendary text studied by anthropology students (Rahmawan & Tiyasmala, 2022). This story, of course, needs to be preserved and passed down to today's younger generation. Jayengrana is one of the characters in which we take pride.

A key issue is that the ancient Jayengrana manuscript exists only in physical book form. The storage of an ancient manuscript in ink and paper form requires challenging maintenance, as these materials are more easily damaged over time, either through fading ink or brittle paper deteriorating due to aging. These ancient manuscripts are also very difficult to access, as they are carefully guarded to prevent rapid deterioration. This is a problem that needs immediate attention.

The aim of this research is to digitize the visual transformation of ancient manuscripts as part of the nation's historical heritage, using the turtle graphics algorithm. This digitization can be applied to designing batik art, which has not yet been explored by other researchers, making it a unique contribution of this study.

The turtle graphics algorithm is a graphical interpretation of L-systems that operates without requiring direct geometry calculations. Turtle motion can be controlled by specifying the number of steps the turtle moves, the degrees it rotates left or right, and whether it carries a pen that is lowered or raised. If the pen is lowered, the turtle's path will be visible along its steps; if raised, the path will not appear (Goldman et al., 2004). Programming to control turtle motion can be achieved with the Mupad programming language (Majewski, 2005), Software Processing (Ratnadewi et al., 2022), and Python (Elance, 2019). The turtle graphics algorithm has been applied to *kawung* batik motifs, comparing the resulting motifs formed by the algorithm with those produced through edge detection (Ratnadewi, Prijono, et al., 2020). Motifs generated with the turtle graphics algorithm show clearer edges and overall quality compared to those

produced by other edge detection methods, demonstrating the reliability of the turtle graphics algorithm.

The use of turtle graphics algorithm has also been applied to various batik patterns from different regions, including Batang batik with motifs such as grape, *jamblang papat* and *kawung jenggot* (Ratnadewi et al., 2024); Ciamis batik with lotus, orchid vine, and *cupat manggu* motifs (Ratnadewi et al., 2021a); Hokokai batik with butterfly (Ratnadewi, 2023c), and sakura motifs (Ratnadewi, 2023d), Banyumas batik with *jahe srimpang* and *lumbon* motifs (Ratnadewi et al., 2021c); Purwakarta batik (R. Ratnadewi et al., 2021c); Kalimantan batik with *shaho* (Ratnadewi, 2023b), and *batang garing* motifs (Ratnadewi, 2023a); Sulawesi batik with *kawali/badik* motifs (Prijono et al., 2022), and Bugis *lontara* script motifs (Hangkawidjaja et al., 2022); and Tasikmalaya batik with *bilik*, umbrella, *Sukapura parang daun* motifs (Ratnadewi et al., 2021b), all of which feature simpler patterns. The resulting vector images are very easy to resize. Scaling vector images does not pose a problem, as the shape remains unchanged when enlarged or reduced. This is not achievable with photographs, where scaling can lead to image quality issues. This scalability is one of the key advantages of vector images created using the turtle graphics algorithm.

Another advantage when creating batik motifs using the turtle graphics algorithm, the creator needs to create a sequence of program listings so that the turtle runs according to the desired motif lines. The program maker needs to determine how many steps the turtle walks, determine when the turtle should turn, how many degrees the turtle needs to turn right or left, when the pen is lowered, when the pen is raised, and so on. These commands are typed in the program listing, so that when the program is run the turtle will form the desired motif. This skill needs to be trained by the programmer. If the execution result is not as desired, it is necessary to improve the program so that the result is in accordance with the desired motif. This process is done repeatedly until the result is the same as the desired motif. Program storage requires less memory than image storage. This is of course another advantage because it saves memory and the image quality remains good (Ratnadewi, Pandanwangi, et al., 2020).

The above factors provide the background for creating motifs using the turtle graphics algorithm. Naturally, the complexity of each motif

presents a challenge in directing the turtle's motion. Each motif requires a unique approach to determining the turtle's movement to ensure the final design matches the intended image for digitization. This research focuses on digitizing motifs derived from the transformation of the ancient *Serat Menak* manuscript. By digitizing *Serat Menak*, its preservation is safeguarded, and those who wish to study it can easily access the manuscript without the risk of damaging the original documentation, which is more fragile in paper and ink form. The creative industry stands to benefit as well, since digital images are easier to replicate, offer higher quality, and allow for more reliable documentation. In digital form, motifs are easier to duplicate and adapt, enabling the creative industry to design both classic and contemporary batik as needed while preserving their authenticity.

Method

Turtle Graphics is a visual programming method used to teach basic programming and graphics concepts (Elance, 2019; Pandanwangi et al., 2022; Ratnadewi, Pandanwangi, et al., 2020). By using Turtle Graphics, users can draw various shapes and patterns with just a few lines of code (Chung, 2000; Ju et al., 2004; Prijono et al., 2022). In this article, we will explain the method of creating motifs using the Turtle Graphics algorithm, including the necessary steps and an example of its implementation.

The programming language used in this study is Python, one of the most popular languages for Turtle Graphics. Google Colaboratory facilitates team collaboration, enabling researchers in different locations to access and work on the program simultaneously. In Google Colaboratory, ensure you have access to the turtle library. To install it initially, use the `!pip install ColabTurtle` command. Then, set parameters such as the turtle's movement speed (e.g., `speed(5)`), the background color (e.g., `bgcolor("white")` for white), and the pen color (e.g., `color("black")` for black). Python recognizes many common color names, such as red, green, blue, yellow, black, white, orange, purple, cyan, and magenta. You can also use hexadecimal color codes, such as #FF0000 for red, #00FF00 for green, and #0000FF for blue. The RGB (Red, Green, Blue) format can also be used with values from 0 to 255, for example, (255, 0, 0) for red, (0, 255, 0) for green, and (0, 0, 255) for blue."

To create more complex motifs, it is recommended to use functions. The command to create a function is `def function_name():`. To call the function, type `name_function()`. Functions can be called repeatedly making it easier to create motifs with many repetitions while saving time and effort and reducing errors. Functions allow programmers to divide code into smaller, more organized parts. By separating program logic into different functions, the code becomes easier to understand and manage.

Next, to repeat several commands, a loop can be used with the command for i in range (many repetitions). Loops allow programmers to run the same block of code multiple times without needing to copy and paste it, saving time and reducing the chance of errors. Loops increase efficiency, simplify data processing, and enable the automation of repetitive tasks. By understanding how to use loops, programs can be written more flexibly and efficiently.

The turtle can also be positioned within the drawing space using the `goto(column, row)` command. This command allows the programmer to move the pen to a specific position on the canvas based on Cartesian coordinates (x, y). The command to move forward is `forward (number_of_steps)`, and to move backward, use `backward (number_of_steps)`. To rotate right, use `right(degree)`, and to rotate left, use `left(degree)`. The `pendown()` command lowers the pen, so when the turtle moves, its trail is visible as a line or curve. In contrast, `penup()` raises the pen so that the turtle's movement leaves no visible trail. By using a combination of these commands, the desired motif can be created as intended.

Creating patterns using the Turtle Graphics algorithm is not only easy but also enjoyable. With just a few simple steps, users can produce complex and interesting images. This method is ideal for beginners who want to understand programming fundamentals, as well as for those interested in exploring creativity in computer graphics. By modifying parameters and functions, a variety of unique motifs can be created to suit one's imagination.

Result and Discussion

Figure 1 shows a photo of a beautiful woman from the *Jayengrana* manuscript, seated with her face turned to the side, her hair styled with ornaments, and dressed in a kebaya with a side sash.

Figure 1 Photograph of the ancient manuscript of *Jayengrana*

This photo will be outlined using a program with the turtle graphics algorithm. The program's execution results can be seen in Table 1.

Table 1 The function of each part of the *Wong Ayu Ning* manuscript in the *Jayengrana* motif

Function mukakanan()				

def mukakanan():
setheading(20) #kiri
pd()
fd(15)
for i in range(4):
fd(10)
lt(13)
for i in range(4):
fd(5)
lt(25)
	rt(90)
	for i in range(4):#bibir
	fd(3)
	lt(25)
	lt(65)
	for i in range(3):#mulut
	fd(5)
	rt(5)
	for i in range(3):
		bk(5)
		lt(5)
		bk(3)
		rt(80) fd(10)
		rt(80)
		for i in range(4):#hidung
		fd(3)
		lt(15)
		lt(5)
		fd(14)
			lt(40)
			for i in range(5): #mata
			fd(5)
			lt(20) lt(90)
			for i in range(6):
			fd(4)
			lt(15)
			lt(35) #dahi
			for i in range(2):
			fd(5)
			lt(10)
				lt(40)
				for i in range(5): #alis
				fd(5)
				lt(12)
				fd(5) bk(5)
				rt(5)
				for i in range(5):
				bk(4.8)
				rt(12)
				rt(65)
				for i in range(3): #dahi

fd(4) lt(12) rt(10) for i in range(3): fd(10) lt(14) rt(3) for i in range(3): fd(4) lt(20) rt(20) fd(5) pu()				
Function gelungkanan()				

def gelungkanan():
setheading(160) #kiri
pd()
fd(5)
for i in range(7):
fd(5)
lt(18)
	for i in range(8):
	fd(4)
	rt(15)
	for i in range(7):
	fd(3)
	lt(15)
	for i in range(6):
	fd(3)
	rt(15)
		lt(15)
		fd(10)
		rt(115) #kuping
		fd(20)
		for i in range(4):
		fd(4)
		rt(15)
		rt(35)
		fd(5)
		rt(55)
			for i in range(3):
			fd(4)
			rt(15)
			rt(25)
			fd(20)
			pu()
			rt(160)
			fd(13)
			pd()
			fd(5)
			pu()
				

Function gelungataskanan()				

def gelungataskanan():
setheading(180) #kiri
pd()
fd(5)
for i in range(4):
fd(15)
lt(10)
lt(105)
for i in range(4):
#bondu
fd(10)
rt(10)
lt(90)
	for i in range(12):
	fd(5)
	rt(30)
	rt(90)
	for i in range(3):
	fd(5)
	rt(30)
	rt(80)
	for i in range(5):
	fd(9)
	lt(8)
	rt(90)
	for i in range(3):
	fd(5)
	rt(25)
		lt(10)
		for i in range(3):
		bk(5)
		lt(25) lt(80)
		#kuncir
		for i in range(7):
		fd(10)
		lt(25)
		rt(25)
		for i in range(4):
		fd(5)
		rt(25)
		for i in range(5):
		fd(4)
		lt(20)
			for i in range(4):
			fd(4)
			rt(20)
			for i in range(5):
			fd(6) lt(25)
			for i in range(5):
			fd(8)
			lt(15)
			fd(5)
			rt(90)
			for i in range(7):
			fd(8)
			lt(15)
			pu()
				

Function leher()				

def leher():
setheading(100) #kiri
pd()
fd(5)
	for i in range(4):
	fd(10)
	rt(10) lt(110)
	for i in range(3):
	fd(10)
	rt(10)
	lt(110)
		for i in range(2):
		fd(10)
		rt(10)
		lt(40)
		for i in range(2):
		fd(12)
		lt(10)
			for i in range(4):
			fd(3)
			rt(15)
			pu()
				

Function badan()				

def badan():
setheading(150) #kiri
pd()
fd(55)
for i in range(6):
fd(10)
lt(10)
lt(12)
for i in range(10):#tangan
	for i in range(7):
	fd(2)
	lt(25)
	fd(20)
	lt(180)
	fd(17)
	for i in range(7):
	#jari2
	fd(2)
	lt(25)
		lt(185)
		for i in range(3):
		fd(10)
		lt(12)
		lt(85)
		fd(7)
		lt(15)
		for i in range(10):
		fd(15)
		lt(2)
			fd(15)
			rt(20)#pita kanan
			fd(15)
			lt(90)
			fd(10)
			lt(100)
			fd(15)
			rt(144)#pundak kanan
			pu()
			fd(20)
				for i in range(4):
				fd(20)
				rt(7)
				rt(90)
				fd(10)
				bk(10)
				lt(90)
				for i in range(2):#telapak
				fd(5)

```
  fd(15)
  lt(5)
lt(60)
for i in range(5):
  fd(15)
  lt(2)
for i in range(5):
  fd(15)
  rt(3)
for i in range(2):
  fd(5)
  rt(15)
fd(25)
for i in range(3):
  fd(5)
  rt(15)
fd(25) #jari1
```

```
fd(20)
lt(180)
fd(17)
for i in range(7):
#jari3
  fd(2)
  lt(25)
fd(20)
for i in range(3):
#jari3
  fd(5)
  lt(15)
fd(25)
for i in range(2):
#jari3
  fd(5)
  lt(12)
fd(20)
lt(90)  #lengan baju
for i in range(3):
  fd(10)
  rt(12)
```

```
rt(85)
for i in range(5):
  fd(15)
  rt(7)
pu()
lt(190)
for i in range(5):
  fd(15)
  lt(7)
lt(100)
pd()
for i in
range(6):#garis
tengah baju
  fd(20)
  lt(6)
fd(10)
lt(90)#pita kiri
fd(15)
lt(100)
fd(10)
lt(95)
```

```
rt(110)
pd()
fd(10)
lt(17)
for i in range(2):#bahu
kiri
  fd(10)
  lt(4)
for i in range(7):
  fd(8)
  rt(12)
fd(40)
rt(30)
fd(30)
rt(115)
fd(47)
pu()
bk(42)
rt(65)
fd(35)
pd() #tangan kiri
fd(10)
```

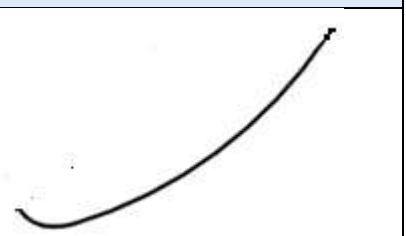
```
  rt(15)
lt(15)
fd(30)
for i in range(3):
  fd(5)
  rt(15)
fd(25) #jari1
for i in range(7):
  fd(2)
  rt(25)
pu()
```

Function baju()

```
def baju():
  setheading(120) #kiri
  pd()
  for i in range(3):
    fd(30)
    rt(10)
  for i in range(3):
    fd(30)
    lt(10)
  rt(155)
  for i in range(3):
    fd(30)
    rt(10)
  for i in range(4):
    fd(30)
    lt(10)
  pu()
```

Function samping()

```
def samping():
  setheading(50)
  pd()
  for i in range(3):
    fd(10)
    lt(15)
  for i in range(3):
    fd(10)
    lt(8)
  for i in range(8):
    fd(40)
    lt(5)
  fd(10)
  pu()
```



Semua fungsi di Tabel 1 ketika digabungkan akan terlihat pada Gambar 2.

All the functions in Table 1, when combined, are shown in Figure 2.

Figure 2 Results of Program Execution
(Source: Research Team, 2024)

Discussion

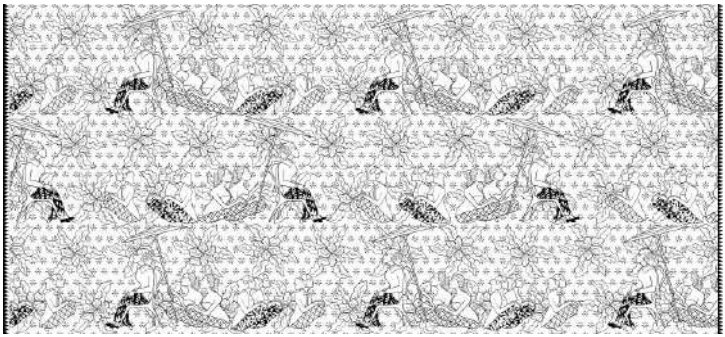


Figure 3 Digital sketch of batik motif
(Source: Research Team, 2024)

Figure 4. Batik *Serat Menak* Motif
(Source: Research Team, 2024)

Figure 4 visualizes a figure seated on a *singasana* chair, shaded from behind by her maids. In front of her, sit three figures arranged in two rows: one directly facing her and two positioned behind. The object is depicted from a side view, which, according to Opan Safari, is an en profile depiction similar to that in *wayang* (Safari, 2011). The sitting and kneeling positions below indicate social status at that time, with important women seated on top and those of lower status kneeling. Although the main female figure is seated above, her gaze is not directed downward as if to communicate, but rather slightly upward, emphasizing her higher social status and authority over the other figures. Her prominent position is further highlighted by the presence of an oversized umbrella shading her.

The arrangement of these figures is organized into a single array, forming a repeating horizontal pattern across a 250 cm stretch of fabric. In the vertical direction, the same repetition pattern fills a 115 cm width. The background of the fabric is decorated with floral motifs that complement the main motif of female figures; notably, no male figures are depicted in this fabric design. This absence suggests that the core message emphasizes the seated female figure as the most dominant or important role. In visual language, Tabrani explains that the figure which dominates and is seated higher is seen as the significant figure (Tabrani, 2012, 2018).

The left and right edges of the fabric feature *tumpal* motifs in the form of vertically aligned equilateral triangles, known as *anam untu walang*. The main figure wears a blue kebaya, while the kneeling figures wear shades of purple: a dark purple kebaya for the figure in front of the main figure, and pink kebayas for the two figures kneeling in the second row. Meanwhile, the two kneeling figures holding umbrellas wear *kemben* (torso-length clothing covering the chest) in blue and purple. This repetition of colors creates a harmonious blend, complementing the floral hues in the background of this batik.

Overall, the placement of the five kneeling figures utilizes a repeated pattern created by one figure using turtle graphics, with the other figures following this pattern. The seated figure, marked by an umbrella indicating her social status, is the main figure in this batik design. This batik cloth stands out from traditional batik for two main reasons: it draws inspiration from the ancient *Serat Menak* manuscript, and it presents a unique arrangement of visual elements, differing from typical Yogyakarta batik. This batik is a storytelling piece based on a fragment of the *Serat Menak* story, making it an innovative creation that can serve as a model for creating and documenting batik inspired by ancient manuscripts.

Conclusion

Turtle Graphics is a program that can be used for a documentation system accessible to many. This system requires minimal storage space yet offers high-quality visual output. The illustrations from the ancient *Serat Menak* manuscript served as inspiration for creating batik motifs using Turtle Graphics. Each visual element is created once and then repeated in

a horizontal pattern—a characteristic commonly found in batik patterns, which is used to develop this *Serat Menak* batik motif. This approach provides significant advantages for batik artisan, as it saves time and accelerates the design process. This breakthrough in technology supports cultural preservation and offers new opportunities for the creative industry.

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DISCUSSIONS ON ART, TECHNOLOGY, AND SPACE SCIENCE

This volume presents a curated selection of papers and reflections derived from the INTERNATIONAL S.E.T.I. CONFERENCE 2024 - International Conference on Art, Technology, and Space Science. The conference convened a multidisciplinary assembly of scholars, researchers, and practioners from across Indonesia, and internationally, including representatives from the United States, the Netherlands, Japan, and Singapore.

The proceedings documented in this volume reflect the intellectual vitality and discursive plurality that emerged from this international forum. The event was held through the collaborative efforts of the Doctoral Program in Cultural Studies (Art and Society) at Sanata Dharma University, Yogyakarta, and the Indonesian Space Science Society (ISSS) as part of the Indonesia UFO Festival (IUF) 2024.

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