Preservation of the Tasikmalaya Batik Motif with Turtle Graphics

Ratnadewi Ratnadewi[1][a], Ariesa Pandanwangi[2][b], Agus Prijono[1][c]
and Andrew Sebastian Lehman[3][d]
[1]*Department of Electrical Engineering, Universitas Kristen Maranatha, 65th Suria Sumantri Street, Bandung, Indonesia*
[2]*Department of Art and Design, Universitas Kristen Maranatha, 65th Suria Sumantri Street, Bandung, Indonesia*
[3]*Department of Computer Engineering, Universitas Kristen Maranatha, 65th Suria Sumantri Street, Bandung, Indonesia*

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Abstract: Tasikmalaya batik is predicted existed since the Tarumanegara Kingdom in the 7th to 9th centuries. The discovery of the Tarum tree as a material for making batik made this assumption even stronger. The split-up of the Mataram Kingdom in the 17th century caused many residents of Kudus, Pekalongan, Tegal, and Banyumas, the majority of whom were batik craftsmen, to migrate to Tasikmalaya. This affected Tasikmalaya city batik. The characteristic of Tasikmalaya batik is the use of bright colours due to the influence of coastal batik. The problem here is because the Tasikmalaya batik motif has not been digitally documented in the digital vector image. The vector image is good quality if it enlarged or reduced and requires less storage memory. Therefore, digital vector image documentation is needed. Turtle graphics is one of the algorithms that can generate vector images. In this article, we will explain Bilik motif, Tasikmalaya umbrella motif, and Sukapura motif. Each motif is formed in a different path will be presented in the form of a pseudocode. The comparison of the turtle graphic result and the original motif shows similarities.

1 INTRODUCTION

Batik motifs are inherited from generation to generation with slight modifications in the present. Based on the survey results of the research team, the current generation seems less interested in batik. This condition makes the inheritance of batik which has been practiced until the present generation more difficult. Possible extinction of the motif that is a big problem if it is not passed on to the present generation. Therefore, the need for documenting the existing motif becomes very important. Batik extinction can be prevented. Batik must be developed by the next generation throughout Indonesia.

Digital batik documentation can be done by making batik photos. The disadvantage of bitmap images, including photographs, is if scaled, they will be less obvious because it is a collection of bits or pixels. The other drawback is the bitmap images require more memory storage. In contrast with bitmap images, vector images good in scaling and requires less memory storage. Therefore, the documentation must be in the form of vector images. The advantage of using vector images is that they are very good at scaling to create better design quality, less memory and storage required.

In this research, batik motifs are formed on the type of vector image using the turtle graph algorithm. The programming language used is Python in Google Collaboratory based algorithm turtle chart of Lindenmayer systems. This programming language can be accessed free of charge which is expected to spur the younger generation to learn Python.

The collaboration of science and art in the study of batik in Indonesia is needed to produce batik with a turtle motif graphic algorithm that can be stored efficiently. This collaboration is expected to help craftman in documenting, developing and producing batik patterns on cloth. In this research, mathematics

[a] https://orcid.org/0000-0001-6487-8101
[b] https://orcid.org/0000-0001-1214-1508
[c] https://orcid.org/0000-0003-6287-8781
[d] https://orcid.org/0000-0003-7311-1209

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is used to formulate the basic pattern of batik using the turtle algorithm in the Python programming language.

The purpose of this research is to produce the invention in the form of program development using the batik pattern turtle algorithm so that the process of making batik motifs and patterns can be used in the centers of craftsmen and the future will become a source of economic improvement of society.The main hypothesis in this study include that function turtles can form the motif.

1.1 Literature Review

Several studies have been conducted on batik, but its development is in the direction of making batik motifs (Yulianto et al., 2019), which explained that Batik Sukapura symbolizes the culture contained in Sundanese (Soemantri et al., 2016; Sunarya, 2019; Susantio, 2009).

This research discusses semiotic theory applied to Batik Sukapura to know the philosophical meaning of the motive. Qualitative methods with the ethnographic approach used by researchers. The sample was derived from the results batik centre in the Sukapura Tasikmalaya area. The result is the geometric patterns and repetitive motif found on many Sukapura. The characteristic of Sukapura batik is that there are many motifs in natural motifs. Signs motif of semiotic studies, not only in the form of Sukapura batik patterns and mathematical regularity, but it has a meaning and a moral message in line with the philosophy of Sundanese people's lives. The combination of semiotic studies and mathematics reinforce students in interpreting the values of ethnomathematics.

Further research is explained that Batik Tasikmalaya has geometric elements and relating to the concept of a flat shape transformation is translation, reflection and rotation (Marom, 2017; Purnomo et al., 2020). The goal is to determine the content of mathematics in Tasikmalaya batik making. Subjects in this study are the batik craftsmen in the area Cigereung, Tasikmalaya. The data collection is done by triangulation of data that is by interview, observation and literature (Nurjamil, 2019).

For further research (Prabawati & Muslim, 2020) that has been argued by disagreements about the relationship between mathematics and culture, which leads to the ethno mathematics. The purpose of research is to describe the ethno mathematics in making umbrella Geulis Tasikmalaya. Methods of qualitative and ethnographic methods considered appropriate. Data collection techniques through observation, interviews and documentation (Creswell, 2014; Yusuf, 2017).

While the use of instruments researchers themselves supported by several other instruments namely observation, interviews, recorders and cameras. Data analysis techniques used in this research is data reduction, data presentation and conclusion or verification. The conclusion of this research is that there is a correlation between Umbrella Geulis and mathematics which has geometric concepts in the form of flat geometry, spatial geometry, symmetry, transformation geometry (reflection, translation, and rotation) and congruence.

Furthermore, the research conducted is (Ambarawati & Agustin, 2019) which aims to describe Indonesian ethnic mathematics in the art of batik Malang in mathematics learning on two-dimensional drawing material. Exploratory qualitative methods are used to explore batik motifs in the form of two-dimensional figures. Results from this study are the motive Malang has the concept of a two-dimensional figure. The concept of a two-dimensional figure can be applied in learning with an innovative learning model.

In subsequent research (Lestari et al., 2018) seeks to develop applications that can identify Balinese batik with ethnomathematical elements. Ethno mathematics is a study that demonstrates the relationship between cultural concepts and mathematics. Ethno mathematics in Bali Batik geometric concepts more in line with the strong elements of Balinese culture. While the identification process using the backpropagation method. Steps backpropagation method is image processing (including scaling and thresholding process). Images are processed incorporated into network applications. This study resulted in the identification accuracy of Balinese batik which contains elements of ethnomathematics.

Of the various explanations of the above study, it turns each has advantages in terms of its findings. While that distinguish the research conducted by the research team are the results of these studies in the form of an invention in the form of a program of making batik by using images of turtles. This research was not done by previous researchers, so expect this enormous research opportunity.

2 METHODS (AND MATERIALS)

The method in this research is descriptive quantitative and qualitative. The making of turtle motifs are

described according to the steps and descriptions.

The method used in the study involved turtle graphics. Before drawing a graph turtle, the batik motif was sketched on paper then the graph equation was sought. Turtle can move forward and draw a line or without draw a line, turtle can turn left with angle δ, turn right with the angle δ, record the present state, or restore the last recorded state.

The state of the turtle is defined as a triplet (x, y, α) with Cartesian coordinates (x, y) representing the position of the turtle and the angle α, called the heading (head), which is interpreted as the direction the turtle faces. Given the step size and the incremental angle δ, the turtle can respond to the commands represented by symbols (Figure 1) (Ratnadewi, Prijono, et al., 2020). The methods used for generating the Tasikmalaya batik motif.

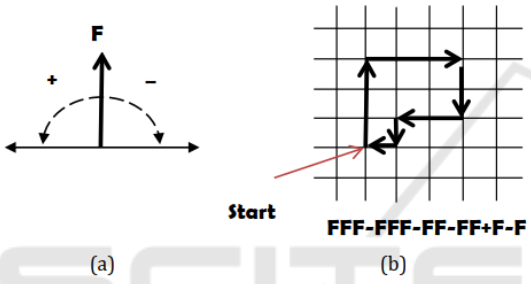

Figure 1: Turtle interpretation of the string symbol F, +, and -. (b) Interpretation of a string: increased angle δ equals 90◦, initially the turtle faces upwards.

Batik in Tasikmalaya can be divided into traditional batik or classic batik and modern batik. The difference between traditional batik and modern batik lies in the colour, meaning, aesthetics, and the way it is made (Yan Sunarya, 2016). Batik Tasikmalaya is batik Sundanese group in the area of East Priangan.

Areas in Tasikmalaya that is famous for their batik heritage include Mangunreja, Sukapura, Wurug, Maronjaya, and Tasikmalaya city.

The Tasikmalaya Batik motifs tend to be simple, and are generally strong in geometric patterns. In addition, Tasikmalaya batik is rich in ornamental flora and fauna. The nuances of Parahyangan are depicted in the motifs of orchids and birds, peacock-ngibing, cala-culu, bali banana, sapujagat, and Awi Ngarambat. Tasikmalaya Batik motifs include: roots, antanan, balimbing, stone background jars, lancah tasik, awi ngarambat, sente, peutey papangkah leaf, udey tsunami, peacock, calaculu, mount kawi, kadaka, sluggish sideways, purple scaffolding, orlet slopes, renfiel, sintung rereng, manuk peutey slong rereng, manuk peutey slong background, peacock with haremis background, peacock ngibing, parang, sidomukti umbrella, dragon sisit, taleus sukaraja, turih-wajit-limar. In fact, kale leaves and spider webs are modified into beautiful motifs in the hands of the Tasikmalaya batik artists. Simple, funny, but no less artistic than other batik motifs (Ochaneysa, 2012).

Tasikmalaya uses the Payung Geulis as the city symbol, inspired by the local wisdom of Tasikmalaya (Figure 2). This Tasikmalaya traditional umbrella, "Payung Geulis", that famous for its beauty means a beautiful umbrella in Sundanese. Tasikmalaya umbrellas are a top umbrella craft, which is produced from an umbrella craft centre in Panyingkiran village, Indihiang sub-district, Tasikmalaya. The people of Tasikmalaya are proud of the Payung Geulis that is the symbol and characteristic of Tasikmalaya.

Figure 2: The symbol of the city of Tasikmalaya (Tasikmalaya, 2013).

3 RESULTS AND DISCUSSION

The Tasikmalaya batik motif is written in the form of a program using the python language with the turtle graphics algorithm stored in a file with the format * .ipynb. While the colour documentation is done by storing the Red, Green, and Blue values as text. So that the memory needed is only 1KB.

3.1 Tasikmalaya Bilik Batik Motif

Bilik in everyday life can be used for house walls, sitting mats, household items such as sieves, boboko, dulang, hihid, aseupan, nyiru, and pipiti. Inspired by this bilik motif, batik is made with the cubicle motif. The basic chamber matting has a bilik tunggal motif (Figure 3) and a bilik dua-dua motif (Figure 4). The naming of this motif is based on the way we weave the chamber. The cubicle motif is also known as Rereng Bilik (Roswandi & Sunaedi, 2013).

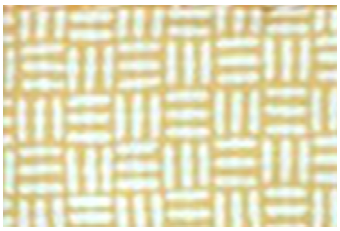

Figure 3: Photo of bilik tunggal batik motif (Diati, 2017).

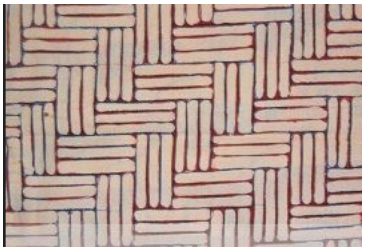

Figure 4: Photo of bilik dua-dua batik motif (Aokhi, 2010).

The bilik tunggal motif and bilik dua-dua motif has the similar motif, except the length and position are different. The vertical bilik motif formation pseudocode in python language that is run in the Google collaborator can be seen in Table 1 (Ratnadewi, Prijono, et al., 2021a).

Table 1: Pseudocode vertical bilik motif.

Step	Pseudocode
1	initialize turtle
2	push the pen
3	for j ← 1 to 2 do
4	for i ← 1 to 18 do
5	forward(2)
6	turnright(angle←10)
7	end for
8	forward(85)
9	end for

When the program is run, a vertical base bilik motif will be generated as shown in Figure 5.

Figure 5: Vertical base bilik motif (Ratnadewi, Prijono, et al., 2021a).

Table 2 show pseudocode to create the basic horizontal bilik motif (Ratnadewi, Prijono, et al., 2021a):

Table 2: Pseudocode horizontal bilik motif.

Step	Pseudocode
1	initialize turtle
2	turnleft(angle←90)
2	push the pen
3	for j ← 1 to 2 do
4	for i ← 1 to 18 do
5	forward(2)
6	turnright(angle←10)
7	end for
8	forward(85)
9	end for

When the program is executed, it will produce a basic bilik motif vertically as shown in Figure 6. The repetition of three vertical and horizontal basic bilik motifs produces bilik tunggal motif (Figure 7). With a slight modification of the length of the motif, bilik dua-dua batik motif can be formed such as shown in Figure 8.

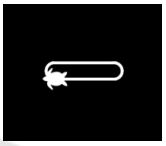

Figure 6: Vertical base bilik motif (Ratnadewi, Prijono, et al., 2021a).

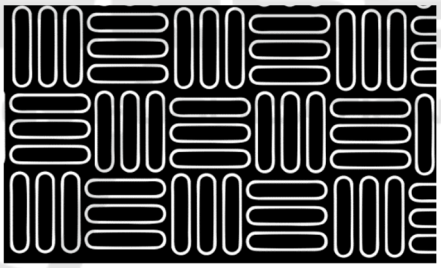

Figure 7: Repetition of vertical and horizontal bilik motifs into bilik tunggal motifs (Ratnadewi, Prijono, et al., 2021a).

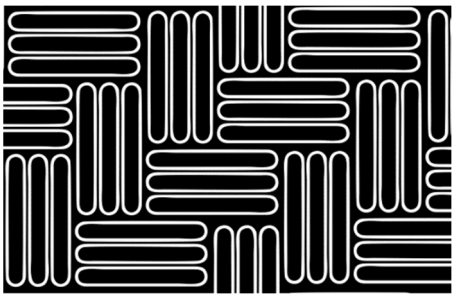

Figure 8: Repetition of vertical and horizontal bilik motifs into bilik dua-dua (Ratnadewi, Prijono, et al., 2021a).

The colors used in the single motif batik cloth are the basic colors R = 239, G = 206, B = 140 and the motif colors R = 239, G = 239, B = 222.The

reconstruction results of these coloring can be seen in Figure 9.

Figure 9: Reconstruction image of bilik tunggal motif.

The colors used in the single motif batik cloth are the basic colors R = 117, G = 181, B = 160 and the motif colors R = 218, G = 181, B = 160.The reconstruction results from these coloring can be seen in Figure 10.

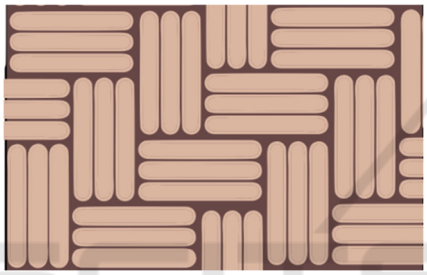

Figure 10: Reconstruction image of bilik dua-dua motif.

3.2 Umbrella Motif Upside Down from Tasikmalaya

Tasikmalaya umbrella is well known for its artistic beauty throughout the archipelago and even the world. The umbrella motif is designed with alternating purple colour gives the impression of a beautiful and attractive with the addition of curves and rectangles that resemble recurrent wajit (Fig. 11).

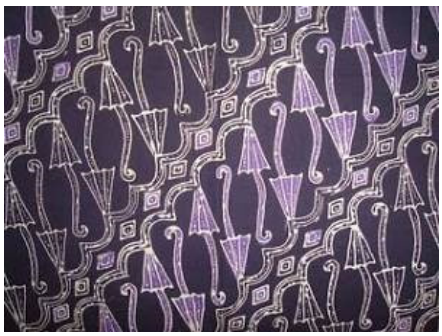

Figure 11: Photo of umbrella upside down motif (Ratnadewi, Pandanwangi, et al., 2021).

The pseudocode for creating an upside-down umbrella motif can be seen in Table 3 (Ratnadewi, Pandanwangi, et al., 2021)

Table 3: Pseudocode upside-down umbrella motif.

Step	Pseudocode
1	initialize turtle
2	Pop the pen
3	Goto(400,100)
4	push the pen
5	turnright(angle←176)
6	forward(132)
7	Goto(400,100)
8	turnleft(angle←12)
9	forward(132)
10	Goto(400,100)
11	turnright(angle←24)
12	forward(132)
13	Goto(400,100)
14	turnright(angle←12)
15	forward(132)
16	turnleft(angle←130)
17	for j ← 1 to 5 do
18	forward(6.1)
19	turnright(angle←22)
20	end for
21	turnleft(angle←130)
22	for j ← 1 to 5 do
23	forward(6.5)
24	turnright(angle←21)
25	end for
26	turnleft(angle←130)
27	for j ← 1 to 6 do
28	forward(6.1)
29	turnright(angle←22)
30	end for
31	Pop the pen
32	Goto(390,232)
33	push the pen
34	turnright(angle←5)
35	forward(20)
36	for j ← 1 to 6 do
37	forward(15)
38	turnright(angle←8)
39	end for
40	for j ← 1 to 4 do
41	forward(12)
42	turnleft(angle←5)
43	end for
44	for j ← 1 to 15 do
45	forward(4)
46	turnleft(angle←15)
47	end for
48	turnleft(angle←160)
49	for j ← 1 to 14 do
50	forward(2.7)
51	turnright(angle←15)
52	end for
53	for j ← 1 to 4 do
54	forward(10)
55	turnright(angle←5)
56	end for
57	for j ← 1 to 7 do
58	forward(13)
59	turnleft(angle←8)
60	end for
61	forward(31)

Upside-down umbrella motif program results can be seen in Figure 12.

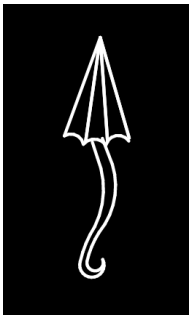

Figure 12: Results of the turtle graphics of an alternating umbrella motif (Ratnadewi, Pandanwangi, et al., 2021).

Results repetition upside-down umbrella motif program can be seen in Figure 13.

The colors used in the upside-down umbrella motif batik cloth are the basic colors R = 80, G = 82, B = 107 and the motif colors R = 156, G = 123, B = 165. The reconstruction results of these coloring can be seen in Figure 14.

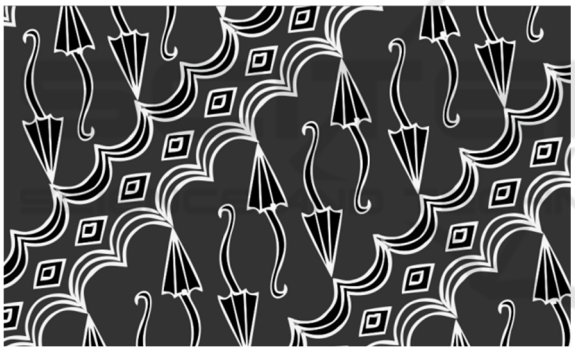

Figure 13: Hasil turtle graphics upside-down umbrella motif (Ratnadewi, Pandanwangi, et al., 2021).

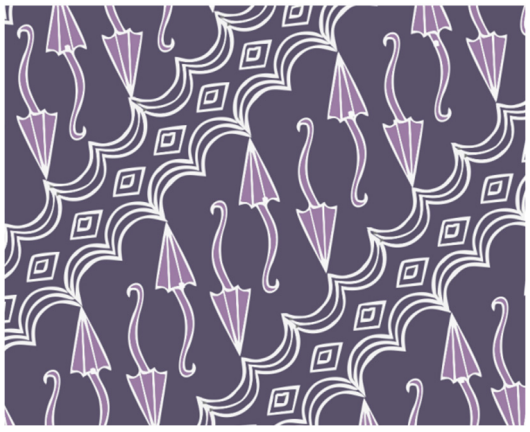

Figure 14: Reconstruction image of umbrella motif upside down.

3.3 Tasikmalaya Geulis Umbrella Motif

Variations umbrella motif created by creating an umbrella open and closed, placed in a row and limited the dividing line on each umbrella, gives a sweet impression with green and brown colour combined with green and broken white as a barrier (Figure 15).

Figure 15: Photo of Tasikmalaya geulis umbrella motif (Umum, 2012).

The pseudocode for making an open umbrella pattern can be seen in Table 4 (Ratnadewi et al., 2011) :

Table 4: Pseudocode open umbrella motif.

Step	Pseudocode
1	initialize turtle
2	pop the pen
3	Goto(400,100)
4	turnright(angle←160)
5	push the pen
6	for j ← 1 to 10 do
7	forward(15)
8	turnright(angle←1.5)
9	end for
10	forward(5)
11	pop the pen
12	Goto(400,100)
13	turnleft(angle←40)
14	push the pen
15	for j ← 1 to 12 do
16	forward(15)
17	turnright(angle←1.9)
18	end for
19	pop the pen
20	Goto(400,100)
21	turnleft(angle←45)
22	push the pen
23	for j ← 1 to 15 do
24	forward(15)
25	turnright(angle←2.5)
26	end for
27	Repeat step 2 to 26 for left side
28	turnleft(angle←155)
29	Make the umbrella handle

Umbrella geulis pattern making algorithm turtles can be seen in Figure 16. The colors used in the back and forth umbrella motif batik cloth are the basic color R = 219, G = 219, B = 219 and the open umbrella motif color R = 73, G = 96, B = 44, the closed umbrella motif color R = 142, G = 80, B = 21. The reconstruction results of these staining can be seen in Figure 17.

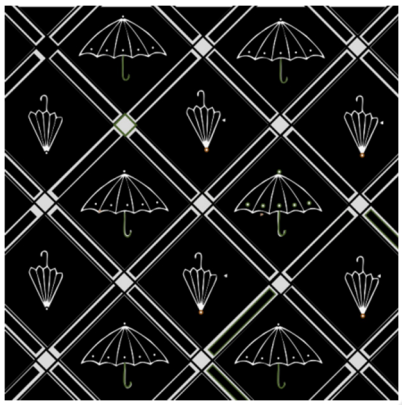

Figure 16: Result of the turtle graphics of the geulis umbrella batik motif (Ratnadewi et al., 2011).

Figure 17: Reconstruction vector image of umbrella geulis motif with turtle graphics.

3.4 Sukapura Leaf Parang Batik Motif

Based on data from the batik museum, it is stated that the parang comes from the word coral or rock. This decline declining diagonal draw a line from high to low and have a slope of 45 degrees. The basic pattern is the letter S (Ratnadewi, Pandanwangi, et al., 2020). Parang motifs form itself can be used as a motif with the addition isen resemble rectangular wajit (Figure 18). Sukapura batik motifs, parang tasikmalaya leaf, is a blend of parang motif with natural motifs are leaves. The combination of parang motif with leaf motif give the impression of a charming and elegant coupled with isen parang motif in the background and a different background color for Sukapura leaf parang motif (Figure 19).

It is undeniable that this batik has its own privileges. Sukapura batik was made by an old woman, a batik maker in Sukapura Village, a village in West Java that is not too easy to find. Batik with the typicalsss colors of Sukapura is also rare. Unlike other batik which is colorful like rainbow, Sukapura batik retains its classic colors. This beautiful batik can be categorized as collectibles. Batik Tulis is made through a long and detailed process. The manufacturing process for one piece of fabric can take anywhere from 2 weeks to months, depending on the level of difficulty and subtlety. . (Ochaneysa, 2012).

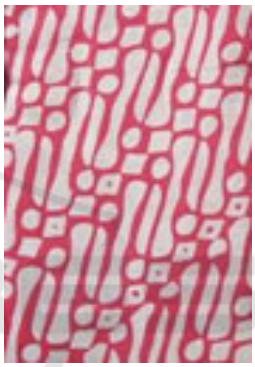

Figure 18: The batik parang rusak motif (Diati, 2017).

Figure 19: Photo of Sukapura leaf parang batik motif (Diati, 2017).

The pseudocode for making an parang rusak motif can be seen in Table 5 (Ratnadewi, Prijono, et al., 2021b) :

Table 5: Pseudocode vertical bilik motif.

Step	Pseudocode
1	initialize turtle
2	pop the pen
3	Goto(400,300)
4	Push the pen
	Make big parang rusak motif
5	turnright(angle←17)
6	forward(150)
7	for j ← 1 to 7 do
8	forward(5)
9	turnleft(angle←6)
10	end for
11	for j ← 1 to 18 do
12	forward(3)
13	turnright(angle←3)
14	end for
15	for j ← 1 to 3 do
16	forward(5)
17	turnright(angle←15)
18	end for
19	forward(35)
20	for j ← 1 to 5 do
21	forward(5)
22	turnright(angle←24)
23	end for
24	turnright(angle←2)
25	forward(200)
26	Repeat step 7 to 23
27	forward(60)
	Make little parang rusak
28	Goto(370,320)
29	turnright(angle←2)
30	forward(81)
31	for j ← 1 to 7 do
32	forward(5)
33	turnleft(angle←6)
34	end for
35	forward(34)
36	for j ← 1 to 5 do
37	forward(3)
38	turnleft(angle←24)
39	end for
40	turnleft(angle←20)
41	forward(90)
42	Repeat step 31 to 39
	Make top circle
43	Goto(430,150)
44	for j ← 1 to 76 do
45	forward(2.3)
46	turnleft(angle←5)
47	end for
	Make bottom circle
48	Goto(350,360)
49	Repeat step 44 to 47

The results of the program for making a parang rusak motif can be seen in Figure 20. The leaf motif in Figure 21, and the combination in Figure 22.

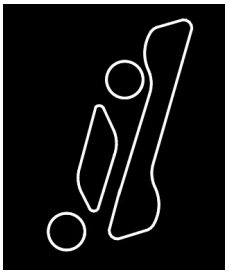

Figure 20: Turtle Graphics Parang rusak Motif (Ratnadewi, Prijono, et al., 2021b).

Figure 21: Turtle Graphics leaf motif (Ratnadewi, Prijono, et al., 2021b).

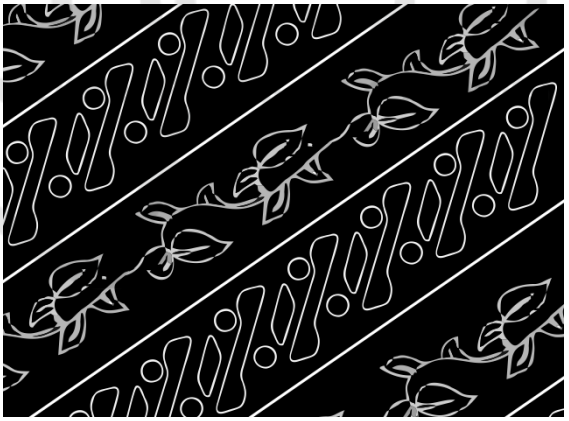

Figure 22: Repetition of the Sukapura Parang leaf Tasikmalaya motif with Turtle Graphics (Ratnadewi, Prijono, et al., 2021b).

The colors used in the back and forth umbrella motif batik cloth are the basic color R = 16, G = 41, B = 24 and the parang motif color R = 173, G = 148, B = 132, the leaf motif color R = 66, G = 41, B = 33. The reconstruction results of this coloring can be seen in Figure 23.

Figure 23: Reconstruction vector image of Sukapura parang leaf motif with turtle graphics.

3.5 Memory for Storage Batik Motifs

Comparison of memory required for storage motif can be seen in Table 6, it appears that the memory required to store the turtle motif on file *.ipynb always smaller than the bitmap image storage.

Table 6: Comparison of memory used to store batik motifs.

Types of motif	Memory used for		
	*.ipynb file memory	*.jpg image in black and white	*.jpg color image
Bilik tunggal motif	35 KB	106 KB	81 KB
Bilik dua-dua motif	35 KB	108 KB	103 KB
Umbrella upside down motif	43 KB	86 KB	269 KB
Umbrella geulis motif	105 KB	121 KB	139 KB
Sukapura Parang leaf Tasikmalaya motif	126 KB	139 KB	208 KB

3.6 The Quality Image

The quality of both bitmap image and vector image fter scaling to 1: 2 against the original image can be seen differences in Figure 24 and Figure 25. Less clear-quality bitmap image edges, the edges look blurry motif, whereas the vector image remains excellent image quality.

The quality of both bitmap image and vector image after scaling to 1: 3 against the original image can be seen differences in Figure 26 and Figure 27. Less clear-quality bitmap image edges, the edges look blurry motif, whereas the vector image remains excellent image quality.

Figure 24: Bitmap image with 1: 2 scaling.

Figure 25: Vector image with 1: 2 scaling.

Figure 26: Bitmap image with 1: 3 scaling.

Figure 27: Vector image with 1: 3 scaling.

4 CONCLUSIONS

In this research has been successfully made batik bilik, upside-down umbrella motif, payung geulis motif, and leaf motif batik parang Sukapura Tasikmalaya are successfully made using turtle graphics algorithms in Python. The memory for storing motifs with a program using turtle graphics in * .ipynb format is smaller than the memory for storing images in the * .jpg format, the image quality of the reconstructed image scaled by the turtle graphics is better than the image quality of the photo image. This turtle graphics batik motif can be used by traditional batik makers when making initial drawings on the cloth, and then the batik craftsmen can color with canting following the batik motif produced by the turtle graphics. The current generation can continue making batik by following batik motifs that have been made with turtle graphics. The existing batik motifs can be preserved by storing the motif digitally with a small memory and good quality.

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