VOL. 15, NO. 12, JUNE 2020 ISSN 1819-6608
ARPN Journal of Engineering and Applied Sciences

www.arpnjournals.com

DEVELOPMENT OF OCTOPUS MOTIF FOR BATIK PATTERN ON WEB-BASED APPLICATION

Dyah Rizky Huzayrha Laitupa, Tito Waluyo Purboyoand Purba Daru Kusuma
Department of Computer Engineering, Faculty of Electrical Engineering, Telkom University, Bandung, Indonesia
E-Mail: titowaluyo@gmail.com

ABSTRACT

The process of making batik traditionally takes a long time. From the many stages in the process of making batik, the stages of scratching usually take a long time. Scratching is to draw a batik motif either on paper or directly on a cloth. Because at this stage the batik maker must think of the desired motive idea, after getting an idea, then the batik maker will draw it on the paper or cloth. With the development of current technology and current science, it can shorten the time needed to create patterns and produce motifs that are more varied by using mathematical models or computational methods. In this Final Project, the Random Walk and Cellular Automata method will be used to develop octopus as a batik motif and produce patterns with many variations.

Keywords: batik, scratching, random walk, cellular automata.

INTRODUCTION

In Indonesia, batik is believed to have existed since the Majapahit era, and became very popular at the end of the seventeenth century or the beginning of the nineteenth century, and incidentally it was only used by family families [1]. Batik is a declining art that has become a tradition in Indonesia. So that batik motifs can be the identity of the wearer. Also in the colonial era, batik distinguished indigenous people from non-indigenous people. Now the meaning of batik as identity changes from regional to national, even international [2]. Batik itself is a cultural expression that has symbolic meaning and high aesthetic value for the people of Indonesia.

Batik motifs have uniqueness and beauty which is one of the founders of the Indonesian character that distinguishes us from other nations so that it can become a national identity and identity. Batik motifs are also called batik patterns or batik patterns. The batik motif is made in the fields of triangles, rectangles, and / or circles. Batik motifs include animal, human, geometric, and other motifs.

Nowadays batik can also be combined with other materials so that traditional elements become modern, known as hybrid culture. In terms of function also experienced a shift. In the past batik for clothes, then shifted to the interior, even now shifted to product design. In terms of manufacturing techniques over time also experienced development, the beginning of which was known was written batik until the early twentieth century and the new batik was known after World War I or around the 1920s. And since industrialization and globalization, which introduced automation techniques, new types of batik emerged, known as printed batik and printed batik. [3].

Now it has been known as batik making techniques with a line of program code that implements algorithms and also computational methods to make and also develop batik motifs to be varied. In making traditional batik from making motifs to batik cloth, it usually takes a long time with this computational technique to shorten the process of making batik.

Octopus is found in the sea and subtropics around the Mediterranean region, the far eastern regions and the South Pacific. Indonesia is geographically an archipelago with two thirds of the ocean area larger than the mainland, and a lot of natural wealth. In Indonesia it is thought to be in the waters of Kalimantan, Sulawesi, Maluku and Banda. Octopus is one animal that has a lot of uniqueness and beauty, including: the uniqueness in the behavior of their lifestyle, the beauty of the structure of different body shapes in each type, and the shape of the arms of the octopus. Octopus has its own unique value and beauty that can be appointed as a batik motif.

In this project, the development of the motif of the octopus was chosen as a batik motif because previously the octopus motif had existed as a batik motif but it was not yet well known as other motifs. Octopus as a batik motif is often found in batik originating from Kalimantan. And if seen by the octopus as a batik motif, it is not inferior to other motifs such as floral and leaf motifs that are often found, the motif of the octopus is unique and beautiful. The development of batik motifs will be used the Random Walk and Cellular Automata methods. It is hoped that this final project can develop the motif of octopus as a batik motif and can be better known by many people.

The aim of this project is to utilize mathematical models to make a batik motif with the PHP programming language inspired by octopus shapes and produce more varied motifs and are expected to shorten the batik design process and make the motif of octopus better known to the wider community.

Batik

Batik is a cultural heritage of the archipelago (Indonesia) that has a high value and blend of art, laden with philosophical meanings and meaningful symbols that show the way of thinking of the people making it. Batik is a craft that has been a part of Indonesian culture (especially Java) for a long time. Batik skills were used as livelihoods and exclusive jobs for Javanese women until

the invention of printed batik that enabled the entry of men in this batik work.

The word batik refers to two things, namely the technique of making patterns and coloring cloth with wax (wax). Based on the international textile literature, the two references refer to the definition of batik as a wax-resist dyeing, which is a certain piece of cloth covered in wax / wax, so that the dye will not be absorbed in the fabric during coloring. Based on the manufacturing techniques, there are 3 types of batik, namely written batik, printed batik, and batik print screen printing

Figure-1. Types Process making of Batik.

Octopus

Octopus is animal phylum mollusca (soft) into the cephalopod class in Latin chepalus (head) and poda (foot) means foot in the head whose habitat is on coral reefs. Animals whose feet are on this head have 8 arms with a suction device that is used to move and catch prey. The arm on the octopus is a layer of boneless muscle, this octopus does not have a shell but has a beak that is used as a jaw. Beak is the hardest part of the body that is used as a jaw to kill prey and bite it into small parts. [5]

Figure-2. Model of Octopus.

Random Walk

Random Walk is a mathematical object known as the stochastic $\{S_n\}$, with $\{S_0\} = 0$ defined by $S_n = \sum_{k=1}^{n} X_k$, where $\{X_k\}$ is an independent random variable and is randomly distributed (iid). A random walk moves that starts at a certain point and moves to a randomly chosen neighbor, from which the same process will be executed. The direction of movement or displacement will be determined by the probability value. The basic example of a random path is to run randomly on integer lines, $\mathbb{Z}$, which starts at 0 and at each step moves +1 or -1 with the same probability. The term random walk was first introduced by Karl Pearson in 1905 [9]. They are used to model different phenomena in mathematics and physics that are widely applied in various fields such as economics, ecology, biology, computer science, and others.

In this final project research uses a random walk method in image processing, to help make batik motifs. The basic concept of this algorithm still considers non-directed graphics. The order of the selected node defines random walk on the graph. Random walks are widely used to solve several image processing problems, we cite here, image enhancement, image segmentation and image registration [10]. The following is an example for writing formulas or equations. Equipped with tagging sequence number equation. And an explanation of the notation used in the equation.

Cellular Automata

Cellular automata is a discrete model consisting of grids of cells, which have limited number values such as ON and OFF. For each cell, a collection of cells is called a neighbor (which can include the cell itself) which is defined to be related specifically to the cell.

CA is a collection of cells colored on a grid with a special shape that develops through a number of discrete time steps with a set of rules based on the circumstances of neighboring cells.

Neighbors are cells that are around one cell. The state of one cell will depend on the cell and the condition of its neighbors. The parameter to the neighbor is often called the R variable, which states the furthest distance of the neighboring cell that still affects the cell. For cellular automata with a dimension of one if it is set to R = 1, then there are 3 cells that play a role in the cell condition i. The three cells are (i), (i-1), (i +1).

METHOD

The system to be created is a web-based application that produces batik motifs where octopus is the inspiration taken to make the batik motif. This system is created using the PHP and HTML programming languages. To produce batik motifs that will be developed using the random walk method and cellular automata to get more diverse batik motifs in a shorter time. The output of this system is a batik motif in JPG format. And here is the scheme of an overview of the batik making process in the application that will be made.

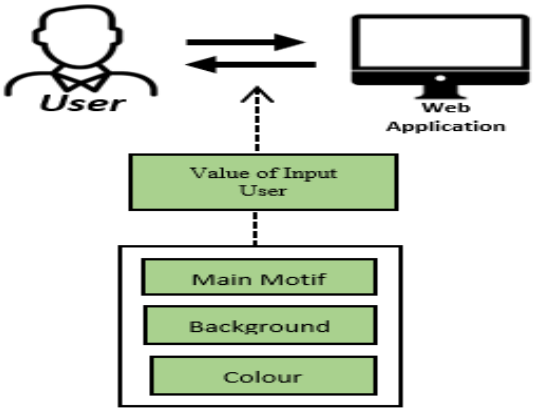


Figure-3. System overview.

The following is an explanation of the general description of the system in Figure-3. This system can modify batik designs by changing some of the input values provided so that the resulting design is more varied and also more diverse. An input form will be created that can be filled in by the user to modify the motif. The input value of this user will affect the main motive, background, and also color. So that users can make designs from batik motifs as desired.

In this study there are several steps that are worked out specifically for making batik motifs. The first step is to identify the main motive pattern, identify the main motives here intended by describing the characteristics that can describe an octopus. Then after determining these characteristics, then pour them into the script so that it becomes the main pattern motif that is desired. And the next step is to design a background / background and also add variations or filler ornaments then determine the color of the motif.

In this system the user can modify the batik motif by changing the input value of the motive parts. The following in the figure below are the parts that can be modified by the user input value.

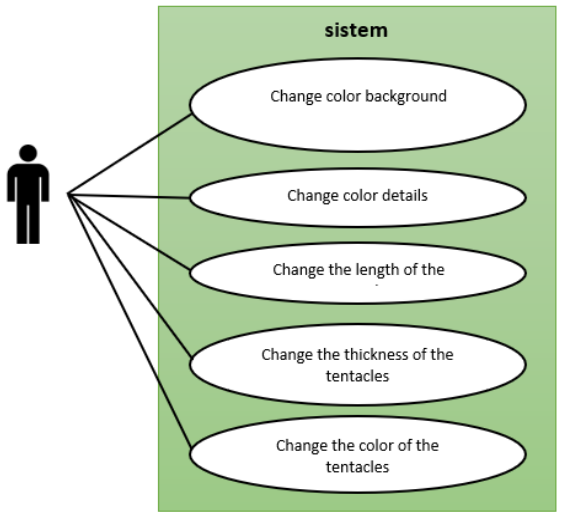


Figure-4. Use case diagram.

The characteristics of the octopus taken and poured into the motif are 8 octopus arm/ tentacles,suction along the octopus's tentacle, and the octopus's arms that move randomly. More or less can be seen in Figure-5.

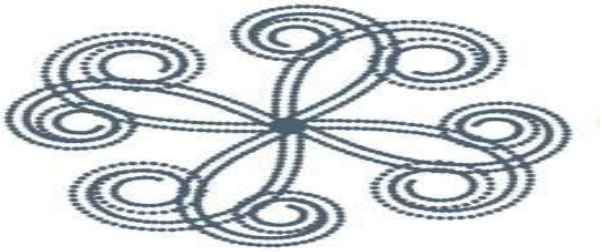


Figure-5. Design octopus motif.

After identifying the characteristics of the octopus which will be lifted into the batik motif, then start making batik motifs. The making of batik motifs is divided into 3 stages, namely the making of background / background, main motives and also inclusion.

Making motifs is made in stages arranged onlayers, starting from the most basic layer, namely the background to the top layer, namely the main motif of the octopus. On the most basic layer or the background is made of a square and colored canvas, the color can be chosen freely by the user. The canvas that is made is 3000 × 3000 pixels. The following in Figure-6 can be seen as an example background.

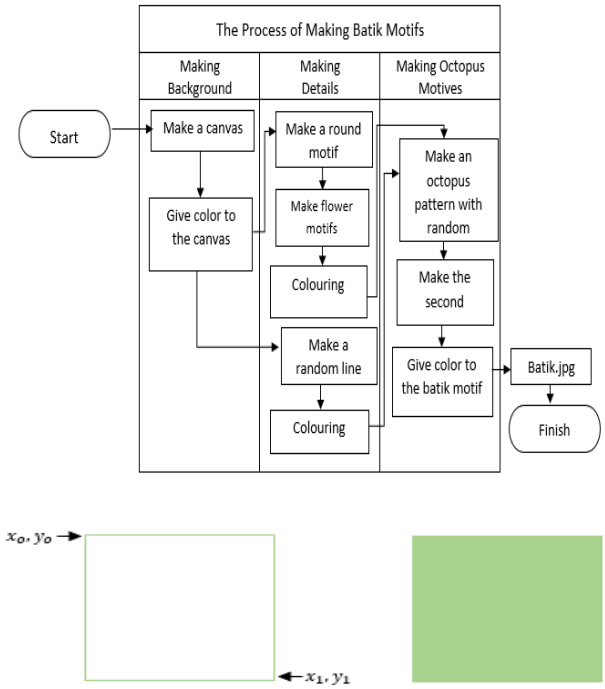


Figure-6. Background.

Then the next layer after the background is the layer to create isenens, there are several inclusion models provided. The isenenen model can be selected according to

the wishes of the user. The following in Figure-7 can be seen the isenential model made on this system.

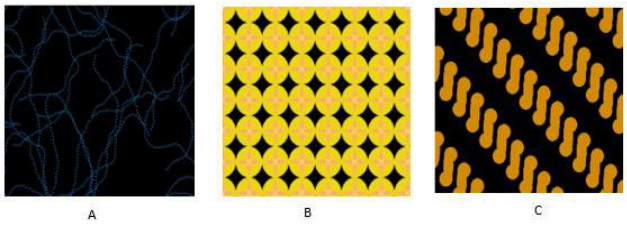


Figure-7. Details Patterns Random Lines (A) Traditional (B) Traditional 2 (C).

The following is an explanation of the process of forming isenen motifs in Figure-8 formed from small circle patterns so that they resemble random dots and runs so as to form random lines, but also there is an isen motif formed from a combination of several patterns such as B and motif C. For the formation of the first B motif made is a circle pattern that is formed side by side, then some patterns of ellipses are shaped like stars. The formation of the C motif is also formed from several ellipse patterns arranged so as to form like traditional batik motifs. In Figure-8 the algorithm can be seen from the process of forming the details.

```
i ← 0
while i < 3000 do
begin
   j ← 0
   while j < 3000 do
   begin
      gambarisen2( )
   j ← j + dh
   end
i ← i + dv
```

Figure-8. Algorithms of details.

In Figure-9 is a general algorithm for forming the details motif. However, there are differences for the equations in gambarisen () in each of the details motifs. Figure-10 is an algorithm of details random lines.

```
cy ← j
cx ← i
α1 ← 0
r2 ← 10
while α1 ← 360
begin
   px ← cx +150
   py ← cy +150
   α2 ← α1
   for k=0 to 200
   begin
      drawgaris( )
      setnextposition( )
   end
end
```

Figure-9. Algorithm of details random lines.

In Figure-9 is a general algorithm for forming the details motif. However, there are differences for the equations in gambarisen () in each of the details motifs. Figure-10 is an algorithm of details random lines.

drawgaris( )
immagefilledellipse()
setnextposition( )

$$p_{y(n+1)} = p_y(n) + r_2 \cdot \sin(\alpha_2) \quad (1)$$

$$p_{x(n+1)} = p_x(n) + r_2 \cdot \cos(\alpha_2) \quad (2)$$

$$\alpha_2 \leftarrow \alpha_2 + rand \quad (3)$$

The explanation of these equations is as follows. In equation 1 and 2, the end position of random line is determined based on the values of the starting position of the segment, the segment length, and the branch segment angle. After the end position of the branch segment is determined, the next process is determining the next branch angle. The next branch angle value is determined by using random walk method as it is shown in Equation 3, which is depended on the current branch angle and IID random number.

```
j ← -3000
while j < 3000 do
begin
   i ← 0
   k ← j
   while i < 3000 do
   begin
     drawisen2()
   k ← k + 55
   i ← i + 55
   end
i ← i + dv
end
```

Figure-10. The algorithm is a traditional motif.

In Figure-11 you can see the right is the traditional details of background algorithm and in Figure-12 is the traditional2 details of background algorithm. Basically, the algorithm is the same as the random details algorithm. So first, the variables i and j aredetermined which are the starting points for making motifs on the canvas. Then the details motif will continue to be drawn to the specified limit, in the algorithm the process will end when the values of i and j have reached 3000, but in this application there are also variables that can change that value so that it can adjust to other variables.

And on the top layer there is an octopus motif, there are two kinds of octopus motifs made, namely the main motif and the companion motif. Two kinds of octopus are made with the following characteristics, octopuses with random tentacle movements and those that are not random movements of tentacles. Octopus is made according to the characteristics described earlier, which has 8 tentacles and sucker that are located throughout the octopus tentacles. But the motif of the octopus is also made in such a way that it still has beauty as a batik motif. For octopus motifs that are random or not, users can change the input values for the thickness of the tentacles, the length of the tentacles and also the color of the tentacles. In Figure-11 you can see the shape of the two kinds of octopus motifs.

```
i ← -100
while i < 3100 do
begin
   j ← 0
   px ← i
   py ← j
   while j < 3100 do
   begin
     drawbulat()
   j ← j + 150
   end
   i ← i + 150
end

y ← -100
while y < 3100 do
begin
   x ← -100
   px ← x
   py ← y
     drawbintang()
   j ← j + 150
   end
   i ← i + 150
end
```

Figure-11. The Octopus motif.

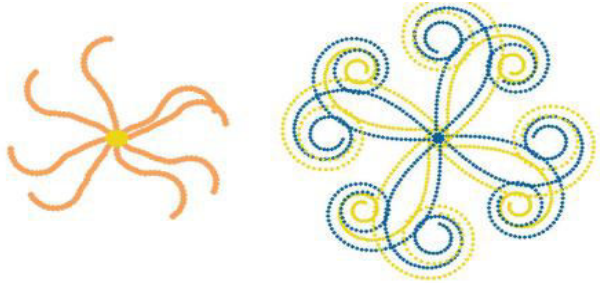


Figure-12. The main motif algorithm.

In Figure-13 the following is a general algorithm for making the whole batik motifs.

The token is set to 0, the token here is used to bring up one of the 2 octopus models. Then the set of variables i and variables j, variables i and variables j here are the starting points where motives are formed. The motive formation will continue until i and j are valued at 3000. The values i and j will always change because they always increase, and the variables d_h and d_v are the variables increasing the value i and j.

As illustrated in the gamburita ( ) algorithm in Figure-13 when the value of token is 0, the octopus model will appear if in addition it will display model2 octopus.

settoken ( )

$$t_{n+1} = \begin{cases} 1, & t_n = 0 \\ 0, & t_n = 1 \end{cases} \quad (4)$$

```
token ← 0
i ← 0
while i < 3000 do
begin
   j ← 0
   while j < 3000 do
   begin
      settoken( )
      gambargurita( )
   j ← j + dh
   end
i ← i + dv
end
```

Figure-13. Draw octopus motif algorithm.

In Figure-14 is drawn optopus motif algorithm, there is if function when token value 0 then draw octopus motif mode1 when the token value 1 then drw the other model of octopus motif. Next in Figure-15 and Figure-16 can be seen the algorithm for each octopus model.

drawtentakel( )

$$\propto_{21} \leftarrow \alpha_2 - 90^{\circ} \quad (5)$$

$$\alpha_{22} \leftarrow \alpha_2 + 90^{\circ} \quad (6)$$

gambargurita( )

```
if token = 0 then
    drawmodel1( )
else
    drawmodel2( )
```

Figure-14. Draw octopus motif algorithm.

```
drawmodel1( )
cy ← j
cx ← i
α1 ← 0
r2 ← 10
while α2 ← α1
begin
    px ← cx
    py ← cy
    α2 ← α1
    for k=0 to 90
    begin
        drawtentakel( )
        setnextposition( )
    end
end
```

Figure-15. Model 1 Octopus Motif Algorithm.

$$p_{y1} \leftarrow p_y + s_{t1} \cdot \sin(\alpha_{21}) \quad (7)$$

$$p_{x1} \leftarrow p_x + s_{t1} \cdot \cos(\alpha_{21}) \quad (8)$$

$$p_{y2} \leftarrow p_y + s_{t2} \cdot \sin(\alpha_{22}) \quad (9)$$

$$p_{x2} \leftarrow p_y + s_{t2} \cdot \sin(\alpha_{22}) \quad (10)$$

setnextposition( )

$$p_{y(n+1)} = p_y(n) + r_2 \cdot \sin(\alpha_2) \quad (11)$$

$$p_{x(n+1)} = p_x(n) + r_2 \cdot \cos(\alpha_2) \quad (12)$$

$$\begin{cases} \propto_2 + {}^{k}/_{p_t}, \propto \bmod 90^o \\ \propto_2 + {}^{k}/_{p_t}, \text{ else} \end{cases} \quad (13)$$

Figure-16 is an algorithm for making a model octopus motif 1. First the j value is entered in the cy variable and the variable value i is entered in the cx variable. Cy and cx variables are the starting point of the process of forming the octopus motif. Where α_1 is the angle used to make this motif. And r2 is the radius for the circle of tentacles that will compile the motif.

In the equation 5 variable α_{21} is the value of α_2 minus 90 will have the angle direction of each tentacle of the octopus motif and that direction will be different from the direction that appears from equation 6. And equation 7 to equation 10 is the equation for the tentacle image following the position (p_{x1} ,p_{y1}) and (p_{x2} ,p_{y2}). Equation 11 to equation 12 is to determine the next value of px and py from the previous equation.

IMPLEMENTATION

The implementation phase is to apply algorithms and mathematical equations that have been made before in the PHP programming language and produce a batik design with a model that has the characteristics of an octopus. The results of batik motifs are displayed on web browser applications that produce output in the form of an image as shown in Figure-17 with the format .jpg (JPEG) with a size of 3000x3000 pixels. In Figure-16 you can see some batik motifs that resulted from the implementation of the batik application.

And for the display of the input form that has been made to modify it can be seen in Figure-17. On the main page of the web application, the user is given several input forms, and on this form that will affect the input value and the results of the batik motif that will be displayed. The input consists of background color input, isenen motif, isen-color color, isen- sis size, octopus motif color, octopus motif size, and distance between octopus motifs. If all inputs are filled in, then the user presses the submit button and the results of the batik motif design will be displayed based on the input from the user on the main page.

Figure-16. Some Batik motives from implementation results.

DISCUSSIONS

The purpose of this test is to find out how the assessment of batik motifs is produced, and to find out whether the input forms that have been made function according to what they are supposed to by testing all existing input forms.

To change the background color can be done on the canvas form by entering numbers in RGB format. In this test it will be done by changing the color in the background 3 times in each isen motif. The input form for background color runs according to its function. The results of background color changes can be seen in the following table.

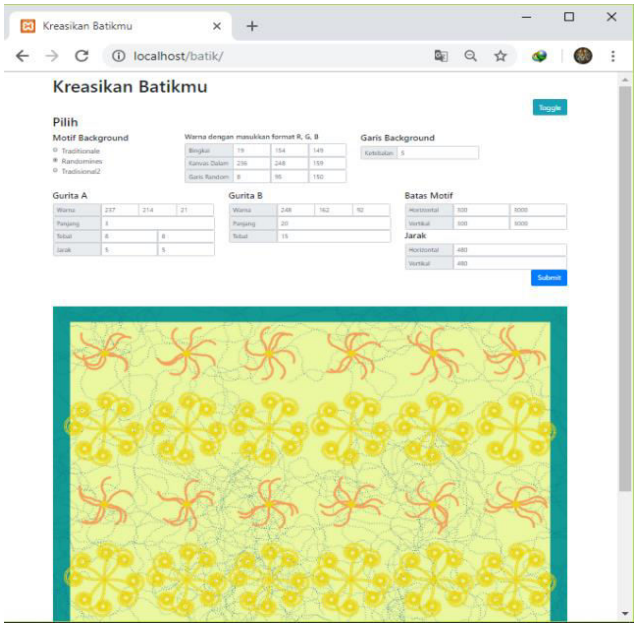
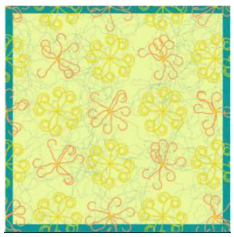
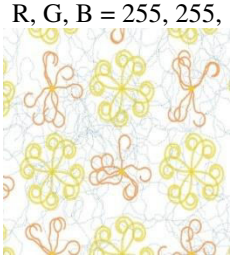
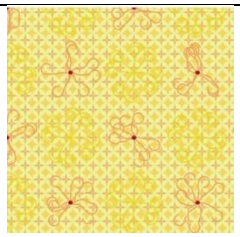
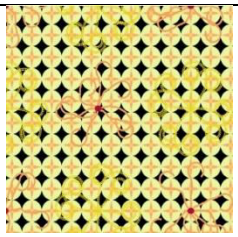
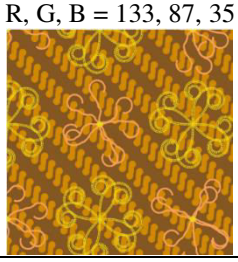


Figure-17. Display on web applications.

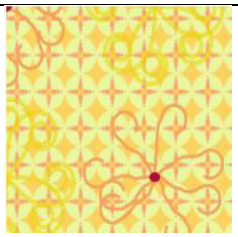
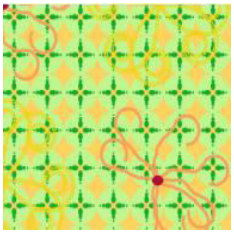
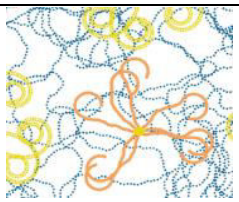
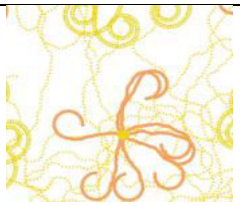
Table-1. Test results form input background color.

Before	After
 R, G, B = 236, 248, 159	R, G, B = 255, 255,  255
 R, G, B = 255, 211, 95	 R, G, B= 0, 0, 0
 R, G, B = 0, 0, 0	R, G, B = 133, 87, 35 

The testing of background details will be done by choosing alternately on the radio button which is assessed that the isenent motif changes according to the chosen motif and also displays the sub menu to modify the chosen isenen motif, because each is isen has different inputs. The initial appearance of the applicationwhere the first step that must be done is to choose the isenent motif first.

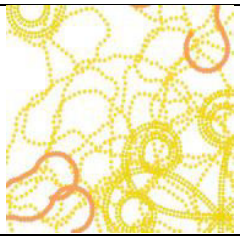
The detail color testing is done by changing the RGB value in the input form and its function goes well as can be seen in Table-2 below.

Table-2. Results of details color tests.

Before	After
 Circle (R,G,B):236, 248, 159 Stars (R,G,B): 254, 168, 119	 Circle (R,G,B):195, 245 145 Stars (R,G,B): 18, 173, 42
 Random Line (R,G,B) : 8, 95, 150	 Random Line(R,G,B) : 255, 217, 51

This test is done on the details randomines motif on the random line thickness form, where the user can modify the line thickness as desired, and the form runs according to its function can be seen in Table-3 below.

Table-3. Results of changes in thickness.

Thickness : 5	**Thickness : 10**
	
Thickness : 15	
	

The second test scenario is white box testing. The target of white box testing is people from various backgrounds ranging from students, or the general public who understand batik. And also some opinions from experts who do know about motives. Tests are carried out objectively where the user can see the batik motifs produced on the questionnaire that has been made.

Table-4. Questionnaire results on google form.

No	Questions	Result
1	Can you differentiate between batik motifs and non-batik motifs?	Yes : 83.1% No : 16.9%
2	Do you know that batik motifs have several criteria so that they can be said to be a batik motif?	Yes : 60% No : 40%
3	In your opinion, what is the need for developing batik motifs in Indonesia?	Very Needed : 86.2% Needed: 13.8%
4	Do you know that batik motifs can be formed using mathematical models? What is your opinion?	Know : 30.8% Don't Know : 69, 2%
5	Do you know about Octopus sea mollusca or commonly known Octopus?	Yes : 87,7% No : 12.3%
6	Here are some batik motifs that are produced after being customized through a web application. Choose one of the Octopus batik motifs that you like!	Motif 1 : 23.1% Motif 2 : 29.2% Motif 3 : 26.2% Motif 4 : 16.9% Motif 5 : 4.6%
7	In your opinion, is the motif of the octopus worthy of being said to be a Batik motif?	Yes : 90.8% No : 9.2%
8	which of the points causes the motive not to be used as a batik motif?	Color combination: 27.7% Ornamen : 24.6% Main Motif : 4.6% Others : 43.1%

Testing is done by making a questionnaire through google form which consists of 9 questions, including the results of the motives produced. The contents of the questionnaire questions can be opened in the form. The number of respondents obtained was 65 people.

In addition to distributing questionnaires from google form to students and general questionnaires were also distributed to several experts in the field of motives to ask for an assessment of the batik motifs that were produced to several batik teachings in Bandung and also several creative industry faculty lecturers at the telkom university campus. The following are the results of the discussion.

CONCLUSION AND FUTURE WORK

Based on the results of making this system, some conclusions can be drawn, the development of octopus batik motifs can be done using the random walk and cellular automata method. Based on the results of black box testing, each variable tested runs according to its function so that it can change the shape of the octopus to be more in accordance with the wishes of the user. Based on the results of testing using quineraries, 89.7% agreed in developing batik motifs using technology, 85.3% said that the need for batik development and 89.7% of respondents said that the results of the implementation of the octopus motif deserved to be said as a batik motif. From the test results it is known that the designs that have been implemented still have some disadvantages, such as 26.4% color integration points, ornament points or 26.4% detail, from the main motive points as much as 4.41%.

Based on the research that has been done, the following are some suggestions for further research for further research on the development of batik motifs, other methods can be used besides random walk and cellular automata. For making the next batik web application, other features are added that can make it easier for users to produce more diverse motifs but still more beautiful

REFERENCES

[1] Prasetyo. A, Mulyana. T. M. S. 2014. Application of Batik Pattern Using Fractal Method and Symmetrical 8 Way Circle Algorithm. 10(2).

[2] Santyaputri. L. P. 2018. Details Book Review in Batik Tatik Suroyo. lecturer of UPH FTPD Visual Communication Design, "https://uph.edu/id/component/vmvews/new/1270-batik-sebagai-identitas-bangsa-indonesia.html" [Diakses 27 Februari 2018]

[3] Pemoeda. 2107. All About Batik that Has Been Hundreds of Years. Batik Seller pioneer pemoeda.co.id, August, 2017,https://pemoeda.co.id/blog/batik, [Diakses 3 Maret 2018]

[4] Supriono. Y. P. 2016. Encyclopedia of the Heritage of Batik Indentitas Pemersatu Bangsa.

[5] Budiyanto. A, Sugiharto. H. 1997. Note about SiTangan Delapan (Octopus / Octopus Sp).

[6] Wijaya. E, Sugiyanto. 2012. Mobile Pakem Batik Nusantara Encyclopedia on the Android Platform.

[7] ____ 2018. Encyclopedia of Indonesian Traditional Batik, Motives, and Diversity of Indonesian Batik. http://batikdan.blogspot.co.id/2011/08/motif-batik.html. [Diakses 6 Maret 2018].

[8] Pemoeda. 2017. All About Batik that Has Been Hundreds of Years. Batik Seller pioneer pemoeda.co.id, August, 2017, https://pemoeda.co.id/blog/batik #2. Cara Membuat Batik. [Diakses 6 Maret 2018]

[9] Kohls. 2016. Expected Coverage of Random Wal Mobility Algorithm.

[10] Chahine. C, Nakib. A, El Berbari. R. 2014. On The Random Walks Algorithm for Image Processing.

[11] Barnes. R. D. 1967. Invertebrate Zoology. W.B. Saunders. Co, London: p. 632.

[12] Wells. M.J. 1962. Brain and Behavior in Cephalopoda. Stanford University Press, Stanford, California. p. 198.