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THE FIBONACCI SPIRAL MOTIFS ON BATIK DESIGN

Wan Norliza Wan Bakar[1]
Junaidi Awang[2]
Mohd Saipuddin Mohd Hasbullah[3]
Muslim Bin Ismail[4]

[1] Faculty of Computer and Mathematical Sciences, Universiti Teknologi MARA Campus Kelantan, Machang, 18500, Malaysia (Email: wliza349@uitm.edu.my)
[2,3] Faculty of Art and Design, Universiti Teknologi MARA Campus Kelantan, Machang, 18500, Malaysia
[4] Perpustakaan Tengku Anis, Universiti Teknologi MARA Campus Kelantan, Machang, 18500, Malaysia

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Abstract: *Fibonacci Sequence is a series of numbers in which each given number is the addition of the two numbers before it. Fibonacci numbers are strongly related to the golden ratio and implies that the ratio of two consecutive Fibonacci numbers tends to approach the golden ratio, which is a proportion roughly 1.16, as the number of term increases. Fibonacci Sequence has been called as 'the nature of secret code 'or 'the nature universal' and we can instantly recognize how this sequence works in nature like an underlying universal grid. In Geometry, Fibonacci Sequence can be illustrated as the Fibonacci Spiral motifs as the squares representing the width of numbers in the sequence. The sequence fit nicely together forming the spiral, this paper aims to discuss on the process of designing four new motifs of batik design based on the Fibonacci spiral motifs.*

Keywords: *Fibonacci Sequence, Fibonacci Spiral, motifs on batik design*

Introduction

Fibonacci sequence is the most famous formula in mathematics.it is a sequence in which each term is the sum of the numbers preceding it. The Fibonacci numbers are defined by the recursive relation defined by the equations $F_n = F_n - 1 + F_n - 2$ for all n is more or equal than 3 where $F_1 = 1,\ F_2 = 1$ where Fn represents the nth Fibonacci number (n is called as an index. The Fibonacci number can elaborately write as 1,1,2,3,5 8,13,21,34. One of the most common experiments dealing with Fibonacci sequence is his experiments with rabbits and Fibonacci asked how many rabbits would be formed in a year (Mirakova, 2014).

Fibonacci Sequence can be found in nature not only in the famous rabbit experiment but also in beautiful flowers, like in the head of sun flowers which are arranged in certain ways so that they follow the pattern of the fibonacci sequence. After examining the arrangement of petals, we would find that the number of petals on a flower that still has all its petals intact and loss any. Flowers with one petal is called as white cally lily, flowers with three petals is named as lily iris, flowers with five petals is denoted as wild rose, flowers with eight petals is delphinium. flowers with thirteen petals are corn marigold (Mirakova, 2014).

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The research on Fibonacci numbers in defining spirals are also in the interest of biologist and physicist because they are frequently observed in various natural objects and phenomena. In reality, Fibonacci numbers can be illustrated as a spiral with squares representing the width of numbers in the sequence. the sequence fit nicely together forming the spiral in example 5+8 equals to thirteen then 8+13 equals to twenty-one and ex cetra.

In batik design there are lot of efforts in producing new motifs such as flora, fauna, microorganism, futuristic idea or even from mathematical ideas (Yasin. R, 2019). The application of mathematical idea on batik design has been a trend to the designers of batik. The contribution of mathematical idea is an innovation that will enhance the productivity of batik in local and international area. The fractal geometry design has become the focus of batik design recently (Yasin. Et Al, Isnanto. Et Al, 2020).

Pursuing this idea, we would like to venture in a new dimension of design that is by using the fibonacci spiral in batik design. The implementation of fibonacci spiral motifs on batik design is a new out coming idea that will liven up batik industry.

Literature Review

Fibonacci sequence is named for Leonardo Pissano, also known as Fibonacci, an Italian mathematician who lived from 1170 to 1250.Fibonacci considered the sequence to be an answer to the following question.

'How many pairs of rabbits will be produced in a year beginning with a single pair if in every month a pair bears a new pair which becomes productive from the second month on?'

The result can be expressed numerically as
1,1,2,3,5,8,13,21,34….

Fibonacci sequence or Fibonacci rose is a pattern of numbers generated by a particular rule (Dunlop, 1997). It starts with 0 and 1, these two numbers are added to get one then new one is added to previous one to make 2 (Mirakova ,2014).

To achieve balance and harmony artists, architects and designers have long been incorporated the Fibonacci sequence with proportion where two consecutive numbers in fibonacci sequence tends to approach the golden ratio, which is a proportion roughly 1.16, as the number of term increases (Sahar Ejemi, 2018).

The Fibonacci sequence occurs very often in nature not only in number form but also in spiral. When arranged in a certain way the Fibonacci sequence creates a special spiral pattern with squares, representing the widths of numbers in the sequence, the squares fit nicely together forming the spiral.in this example,1+1 equals to 2 then 2+3 add up to 5 etc. (Mirakova, 2014). However, Mirakova (2014) noted limited use of fibonacci spiral motifs on textile designs and fashion designers. Since then, research on fibonacci spiral had shown that the design based on fibonacci spiral motifs had been applied on various materials. (Kazlacheva Z., 2014) applied fibonacci rose to textile design along with style lines of garments creating versions of fibonacci series tiling.

Kazlacheva Z., Illieva J., (2015) had presented paper on the use of geometrical forms and tiling created on the base of golden ratio and fibonacci numbers in fashion and textile design. (Illieva

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J., 2016) later then further the studies and presented paper on the use of the golden spiral in textile design. A few years after that in the year 2020 Julieta Illieva continues her research on the development of floral textile patterns on the base of golden ratio. (Julieta Illieva, 2020) then expand the application of golden fibonacci geometry in the design of fashion accessories.

In Southeast Asia, Indonesia is a country that had implemented the fibonacci spiral motifs on batik design. A research done by Naftasari (2011). shown that there was an exploration design of Batik Druju in Kabupaten, Malang, Indonesia. Batik Druju is a motive which used dyed colors on clothes. Batik Druju has the spiral motives that revealed the design of its community. Further research had been done on spiral motives in Indonesia. The advancement of technology allowed the material optimization is required in clothing design. The geometrical information about batik image Ais required in a module for batik design. The cardinal spline curve representation has been used as batik image on Indonesian Batik (Fanani et.al ,2011).

Apart from that, few more researchers had contributed more ideas on how the spirals motifs can be applied (Morawski, 2014) noted that in Aceh one applied the motif Bungong Awan Si On, similar to a short, forked leaf, which one half is coiled in a spiral.

Amidst rapid modernization batik is now considered old fashioned and less favored as an icon of traditional art. Batik designers were trying to move forward in keeping up with current demands of so-called modern society. The quick spreading of trendy – hype has been more familiar to younger generation. The phenomenon calls for a critical outlook on metaphysics of presence lays its foundation on the principle of aesthetic in designing batik. The ukei motif symbolizes the lessons of life. The spiral motif in several temples where chiseled into reliefs of kalpalata being introduced in batik design.

Furthermore, the parang batik is a kind of batik motifs that has slanting parallel rows. Parang consists of 2 elements that are parang and minjan. The slope of paranag forms of 45 degrees pattern. A research was proposed by (Widi Hapsari et al., 2019) producing Parang Batik by using Bezier Curve. The curve is formed based on the of points given.

In Malaysia, there are some of the researches were conducted on the topic of spiral batik by using rational Bezier Curve which is the most popular areas of research in computer aided geometric design. The researcher proposed the field of designing batik by implementing the method using Mathematica. This project deals with the design and development of new tool for designing batik. The experimental results have shown its effectiveness and the potential ability to be a useful tool for batik design (Zulkipli, 2017).

Rational Bezier Curve is well know research areas in computer aided geometric design. It can be specified as quadratic (Ishak, 2017) implemented the quadratic and cubic rational Bezier Curve by manipulating the weight magnitude to generate design more precise to real figure.

Other studies identify the uniqueness climbing floral themes used an Terengganu batik sarongs. Digital image compilation and motif tracing on batik sarong were used to examine the floral climber characters. The relevant and literature was mapped onto batik sarong. Motifs linked to floral elements function and role. The examination revealed that climb flower designs were used and the farming border and upperflower edge part. Various type of tropical flowers was developed as inspiration by batik makers and represent batik sarong Terengganu identity (Zuhir et al., 2022).

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Methodology

Fibonacci Sequence is a pattern of numbers generated by a particular rule (Dunlop ,1997).
it starts with 0 and 1. these two numbers are added to get one, then the new one added to previous one to get 2. this pattern repeat itself as seen below

0+1=1
1+1=2
1+2=3
2+3=5
3+5=8
5+8=13

0.1,1,2,3,5,8,13……. this is known as recursive sequence defined by the equations

$$F_1 = 1, \quad F_2 = 1 \; and \;\; F_n = F_n - 1 + F_n - 2 \; for \; all \; n > 3$$

F_n represents the nth fibonacci numbers.

When arranged in a certain way, the Fibonacci sequence creates a special spiral pattern. The graph paper should be used so that the spiral is perfect.

The process of designing spiral motifs is done by a graphic designer using a special software adobe illustrator.

Two squares with the width of one is drawn. Then more squares are added based on the sequence number.

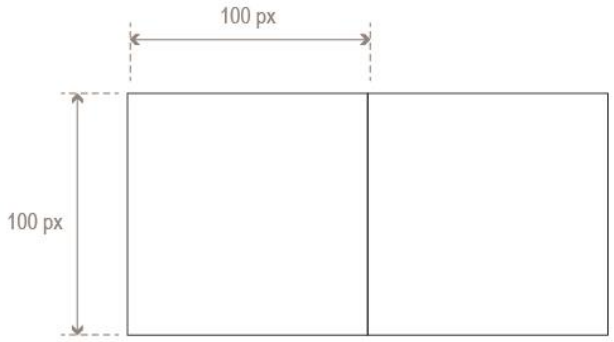

Figure 1: Two squares with the width of one is drawn.

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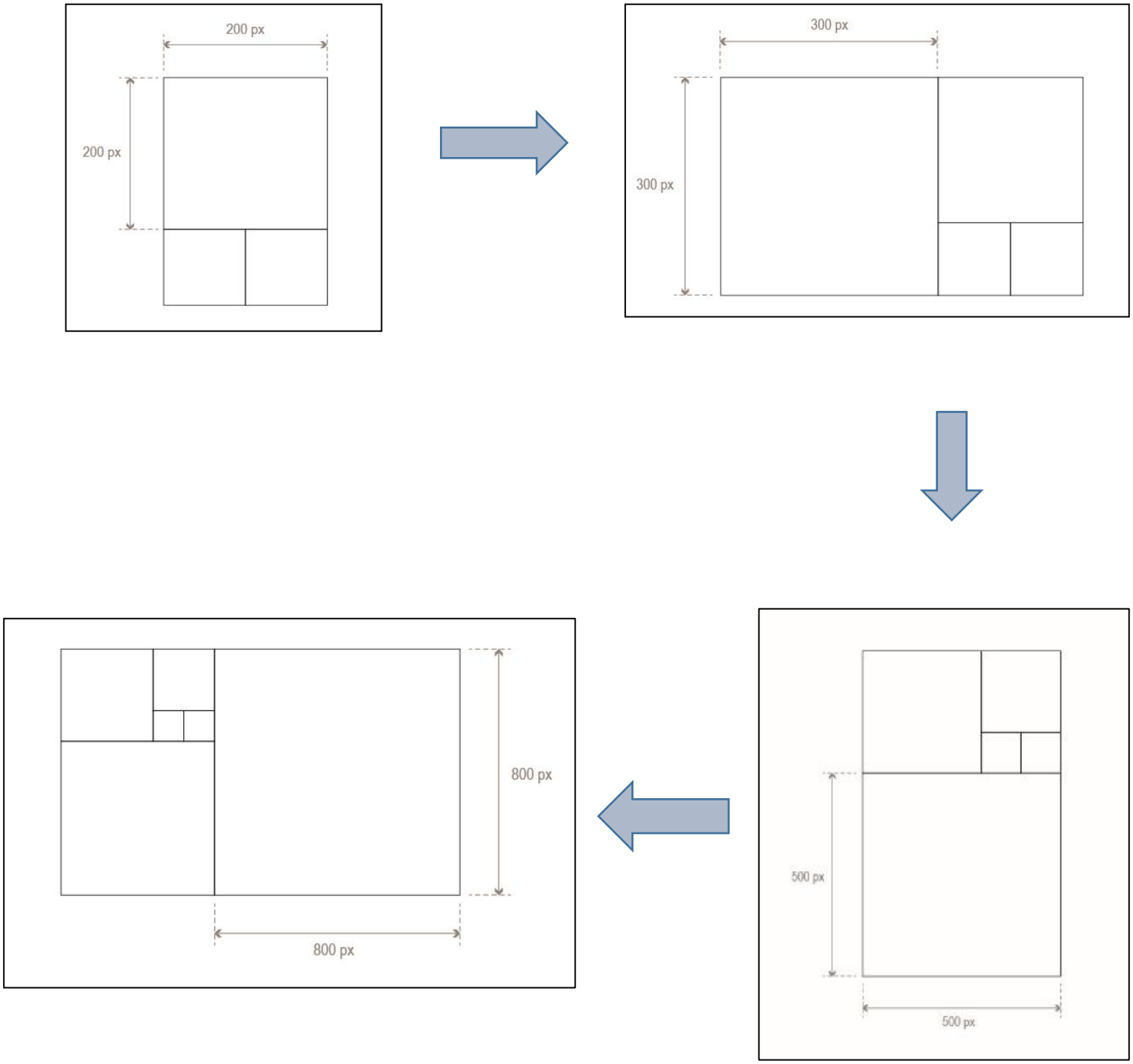

Figure 2: More squares are added based on the sequence number

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Then. draw curve in every square to create a spiral shape

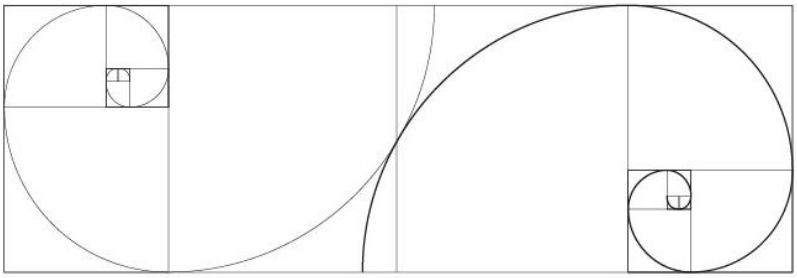

Figure 3: draw curve in every square to create a spiral shape

The spiral can be expanded by adding more squares based on Fibonacci sequence

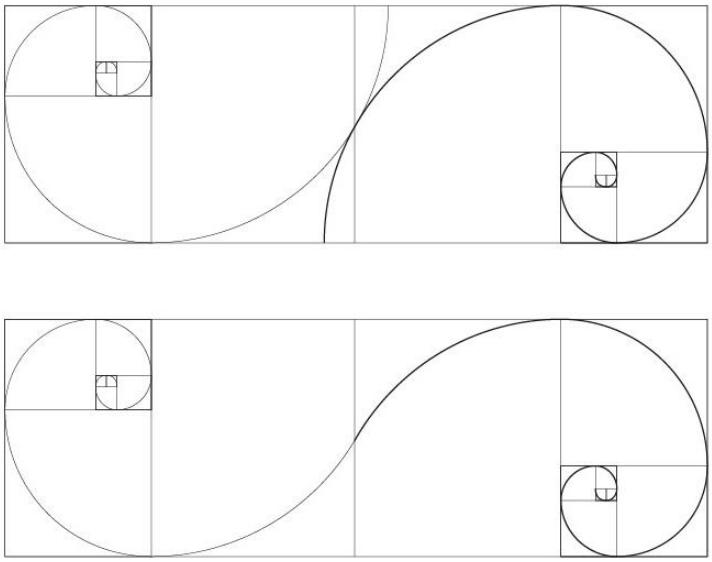

Figure 4: The expanded spiral by adding more squares

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Result and Discussion

The Fibonacci based ideas using organic lines can be further developed to form a motif inspired by the shoot of fern plant.

Figure 5: The development of Fibonacci based ideas to form a motif inspired by the shoot of a fern plant

Lines are added around the bright shapes to show inter lacing and the aesthetic elements to make a pattern.

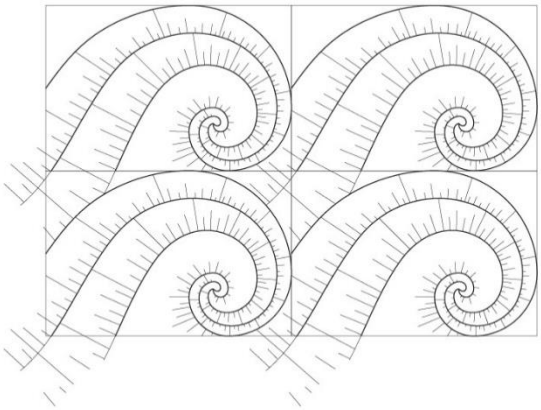

Figure 6: The motifs are arranged in a certain way to create a pattern

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More patterns are then created based on the concept of translation and reflection.

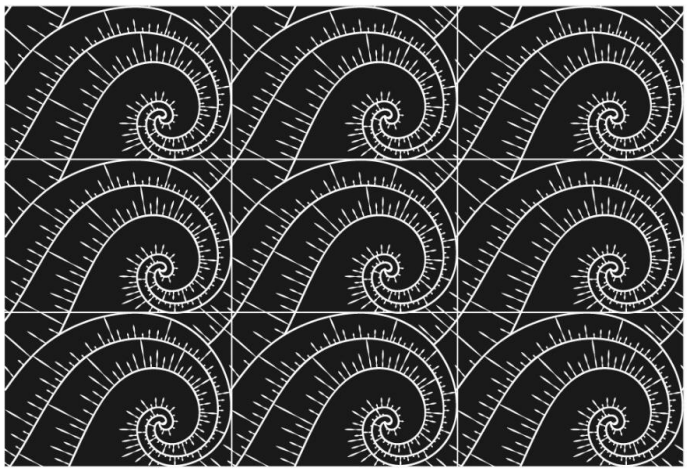

Figure 7: Patterns of Fibonacci based ideas are arranged by the concept of translation

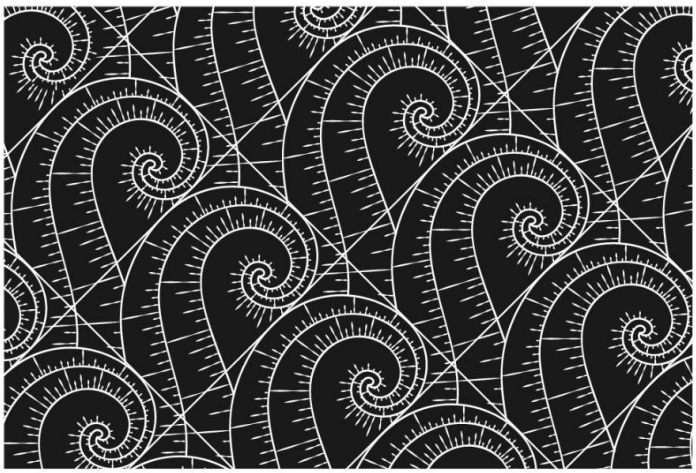

Figure 8: Patterns of Fibonacci based ideas are arranged by the concept of reflection

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The Fibonacci motifs can be applied to batik design where the similar concept is drawn on the piece of cloth by using wax.

Figure 9: Fibonacci spiral motifs is drawn on the piece of cloth by using wax.

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Conclusion

The fibonacci spiral motifs on batik design is a new motif that exists due to the concept revealed by the fibonacci sequence. The mathematical idea underlying it will contribute to the development of new motifs on batik design that will attract the attention of many batik lovers that has a great fond of new incoming ideas. The implementation of it will increase the sale of batik locally and exaggerate more ideas internationally.in future more ideas on fibonacci sequence is hoped to be interpreted to new designs on various elements.

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