International Journal of Science and Research (IJSR)
ISSN (Online): 2319-7064
Index Copernicus Value (2013): 6.14 | Impact Factor (2013): 4.438

# 3D Modeling Indonesia Ring Jewelry Ornament using Iterative Function System

**Suyoto[1], Thomas Suselo[2], B. Yudi Dwiandiyanta[3]**

[1, 2, 3]Universitas Atma Jaya Yogyakarta, Master of Informatics Engineering,
Jl. Babarsari 43 Yogyakarta 55282 Indonesia

**Abstract:** ***In this paper will be presented three-dimensional (3D) modeling of jewelry ornament. Writing this paper is motivated by the fact that local wisdom for gold ring jewelry ornamentfrom "Kendari" Southeast Sulawesi Indonesia is set and fixed pattern. Although the motives vary, but the design is less varied, so that it looks monotonous. For that, they need a design motif that is unique, exciting and high value. The design motif can be generated by the development ofIterative Function System (IFS) that is method of constructing fractal. Fractal is an image with the self- similarity property generated by recursive or iterative algorithms. Fractal structure is a tool to describe the visual effect of one or more objects. 3D modeling of jewelry ornament using OpenGL and C programming. Modeling will be tested using Windows Operating System. This research has produced more than 340 of rings and jewelry designs unique traditional and modern nuances.***

**Keywords:** IFS, 3D, jewelry, modeling, fractal.

## 1. Introduction

Fractal is an image with the self-similarity property generated by recursive or iterative algorithms. Mandelbrot made a term from the Latin *fractus* meaning "split into pieces" or "irregular". Fractal structure is a common tool to describe the visual effect of one or more objects. Fractal Brownian movement is used to produce various models and design objects to create natural phenomena [1]. Fractal is a sub topic of discussion in Computer graphics. Computer graphics is a set of tools that consists of hardware and software to create images, graphics or realistic images for art, game / computer games, images and animated films [2]. In line with the development of science and technology, fractal widely used by scientists and researchers from various fields including, Mathematics, Biology, Chemistry, Bioinformatics, Physics, Engineering (Electrical, Engineering, Information Technology, Geology, etc.), Agriculture, Medicine (Animal, Common, etc.), Economics [3].

Implementation of the new ring design and other fine jewelry that bracelets, earrings and necklaces using unique fractal can be expected to increase the selling power. In economic terms the design manufacture rings and other jewelry with fractal can promote common interests and characteristics of a particular culture that supports the roadmap of research at the University of Atma Jaya Yogyakarta (UAJY) by Research Master Plan (known as RIP) 2010-2014 focused on two things: ( 1 ) multiculturalism and ( 2 ) local wisdom [4].
The 3D visualizations have popular now, plus the OpenGL technologies that have been developed. Due to outstanding performance in the production of realistic 3D graphics, has been almost established as an industry standard in the process of 3D graphics [5]. OpenGL will be combined with the fractal model, which is expected to get a ring design with fractals and 3D.

## 2. Related Works

Fractals are geometric shapes that can be separated into several sections, where each section is obtained from iterations smaller parts. Fractal research conducted by Yulianto and Mauridhi (2012) is based on Gaussian noise generation method for dyeing batik. Batik fractal noise at random points on the surface of the batik fractal, while the method of Gaussian noise models follow a standard normal distribution with a mean of zero and a standard deviation of 1. The generation of noise as basic dye batik fractal patterns formed in the research that has been done, no pixel noise distance error ranging from 9.1 to 13.7 pixels [6].

Fractal currently widely applied in various fields of life. Fractal widely used in modeling to experiment[7], 3 - Dimensional visualization in health [8], image analysis [9]and building design [10]. Fractal itself in Indonesia is widely used to analyze the motif and also designed the motif [11].

Batik is a unique design, intricate, and has the typical characteristics of traditional. The art of making batik design finally is often combined with modern designs in order to create innovative designs. The research was conducted by Li (2009) by using Interactive Evolutionary Algorithm (IEA ) on the system to produce a pattern b tweaking through the process of evolution and applying design patterns made to maintain user interest batik in order not to get bored with the local pattern [12].

Batik and Fractal are two different concepts. Batik is a traditional art, while the fractal is a mathematical concept that addresses iteration. In previous research, the concept of fractal batik is usually studied using several methods. L - systems are used to create a pattern, while the fractal dimension is used as a measuring tool for Batik Fractal order to compare with the traditional batik. Research on the algorithm for making Batik Fractal is then developed into software known as jBatik. jBatik is software to produce motif with 2-dimensional, and make it a tool for creating generative art. Hariadiet.al, have done the research on the incorporation of the concept of fractal batik patterns using L-System and the fractal dimension [11].

In addition fractal widely used also in the field of fingerprint recognition [13], image classification [14], analysis and classification of pieces of ham [15], image analysis and pattern recognition the food industry [16], the introduction of the Arabic script[17], quantization apple slices [18], feature extraction [19], identification of plant leaves [20][21], and the classification of texture [20].

Fractal widely used in pattern generation. Synthetic pattern generation procedure has a variety of applications, and a number of approaches (fractals, L - systems, etc.) have been designed. There are many complete algorithms that can produce all the images are possible, but most images are random and are distinguished by a perceptional. Claude and Lewis (2012) propose a natural research to describe the differentiated perceptual image and argue its validity. Basically, the new representation and pattern generation algorithm will continue to be developed [22].

Courtial and Padgett (2000) presents a simple optical system to produce self-similar fractal pattern. The main component consists of three adjacent lenses, which form multiple images of the pattern displayed on the monitor. Images recorded by the camera and displayed as a new pattern on the monitor. Iterating this process generates an approach to self-similar fractal patterns that are independent of the initial image [23].

Chung and Ma (2005) conducted a study using fractal generation tile pattern. A fractal tile or f- tile is a tile that has the self-similarity and the limit, which is fractal. Mapping Invariant built for the creation of aesthetic patterns on the tiles [24].

Chung, Chan and Wang (2004) developed a new algorithm for the automatic generation of aesthetic patterns on the tiles non-periodic by means of a dynamic system. Mapping Invariant built for the creation of a striking pattern on this tile. A modification scheme convergence time described to increase the attractiveness of artistic images generated. This algorithm can be used to create a wide variety of exotic patterns non-periodic[25].

Suyoto (2006) examined the application of computing and visualization of fractals. There are examples of applications that set Julia' fractal with J2ME on mobile devices. This fractal uses iteration function is $J(c) = d_{k+1} = d_k^2 + c$, where c complex numbers. The initial value $d_0 = c$, and the maximum number of iterations for each position used is 128. Not all values of c can generate fractal Julia set, but so has presented 12 value c with results varying fractal. Fractals are successfully implemented with J2ME [3]. Suyoto in 2005 examines the chances of the use of high-level programming language that is J2ME for computer graphics. Computer graphics is a set of tools that consists of hardware and software to create images, graphics or realistic images for art, computer games, images and animated films. Two examples of computer graphics to make the image appear natural and realistic that the cloud fractals and fractal Mandelbrot sets have been described. Both of this fractal successfully implemented because not using sinusoidal mathematical function. Both fractal was just using that line painting method g.drawLine() and the use of color is g.setColor( ) [2].

## 3. Theory Review

### 3.1 Iterative Function System (IFS) and Fractal

Iterative Function System or IFSs are a method of constructing fractals. Fractals are geometric objects rough on any scale, and looks can be " divided " in a radical way. English of fractals is fractal. Benoît Mandelbrot has created the term of fractal in 1975. The termis from the Latin word *fractus* meaning "broken" or "irregular". Before Mandelbrot introduced the term, the common name for such structures (e.g. Koch snowflake) is a monster curve [1].

Various types of fractals were originally studied as mathematical objects. Fractal geometry is a branch of mathematics that studies the properties and behavior of fractals. Fractals can help explain many difficult situations described using classical geometry, and is quite widely applied in science,technology, and art works of the computer. In the past fractal conceptual ideas arise when traditional definitions of Euclidean geometry and calculus failed to analyze objects such monster curve.

Complex fractal curve can be created recursively by smoothing curve repeatedly. The basic idea of this curve is divide each segment $K_n$ into three equal parts, and replace the middle with protuberance in the form of an equilateral triangle. The Swedish mathematician named Helge van Koch found this pattern in 1904. Koch curve is made with the following rules: on $K_0$ starts with a straight line length l, to iterations to 1 ($K_1$) is divided by three straight lines and starting from 2/3 of an equilateral triangle formed (angle $60^0$). On the second iteration ($K_2$) every straight line results from $K_1$ iterations divided by three and the start of 2/3 of an equilateral triangle formed (angle $60^0$). Figure 1 shows this.

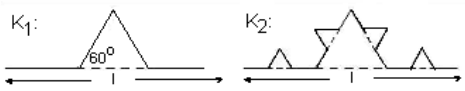


**Figure 1:** Koch' curve

### 3.2 Pattern

Almost all objects have a pattern. A pattern is basically a regular arrangement of an object or space. Pattern can be regular and irregular. Regular pattern would be easier to detect. The detection pattern can also be referred to as pattern recognition. The pattern of an object or objects can be regarded as defining identity and can be given identification or name [26].

Pattern Recognition can be considered as the human ability to recognize objects based on various characteristics and storing knowledge of object ever observed [27]. The goal of pattern recognition is to classify and describe the pattern or complex objects through knowledge the nature or characteristics of the object [28]. Pattern Recognition approach in this paper is the introduction of a pattern of an object.

## 4. Purpose System

The proposed system consists of four main steps, namely (1) creating graphics windows environment, (2). Iterative function system (IFS) that is a method of constructing fractals, (3)OpenGL graphics processing and (4) Output the result.

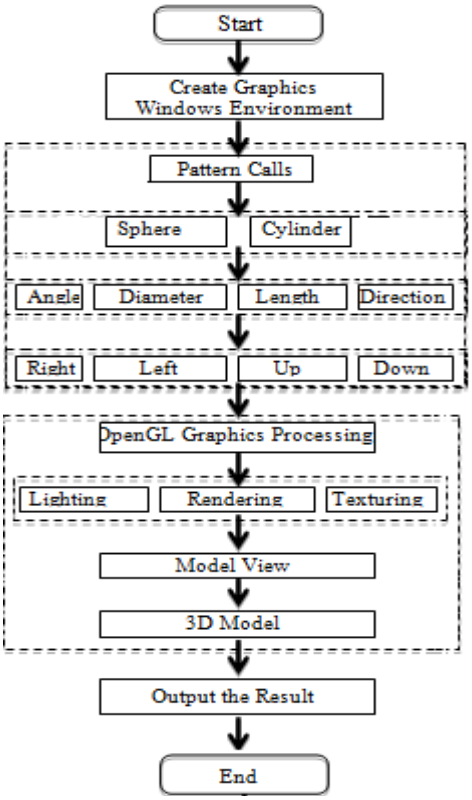


**Figure 2:** Development of the 3D Modeling using IFS and OpenGL

Figure 2 shows the development of the 3D Modeling using IFS and OpenGL, when in Figure 3 shows the quasi code used for it.

1. Start□
2. Create Graphics Windows Environment
3. Loop
3.1. PatternCalls
   - Sphere
   - Cylinder

3.2. Divide Branch
   - Angle
   - Diameter
   - Length
   - Direction
     - Right
     - Left
     - Up
     - Down

4. Until (end iterations) □
5. OpenGL graphics library or Function Calls
   - Lighting
   - Rendering
   - Texturing

6. Display Model □
   - 3D Model □

7. Output the Result □

End

**Figure 3:** The Quasi Code for Development of the 3D Modeling using IFS and OpenGL

## 5. Result of Simulation

Modeling and creation of the graphic environment are two important stages of computer graphic [29]. To implement and simulate the development of the 3D Modeling Indonesia Ring Jewelry Ornaments, C programming and OpenGL functions are used.

Here are four examples of modeling images: “Kendari Batik Parang”, “Kendari Batik Pamiluto”, “Kendari Batik Sidomukti” and “Kendari Batik Ranting Cirebon”.

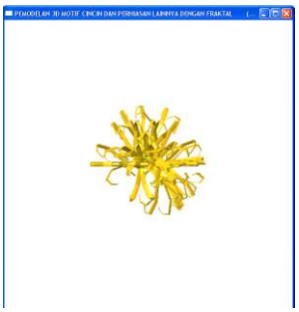

**Figure 4:** The Display 3D Model of Ring Jewelry of“Kendari Batik Parang”, n=5.

**Figure 5:** The Display 3D Model of Ring Jewelry of “Kendari Batik Pamiluto” n= 5.

**Figure 6:** The Display 3D Model of Ring Jewelry of “Kendari Batik Sidomukti; n=6.

**Figure 7:** The Display 3D Model of Ring Jewelry of “Kendari Batik Ranting Cirebon”, n=3.

Modeling ring by using IFS generate a lot of interesting models. As seen in Figure 4, the display 3D model of ring jewelry of "Kendari Batik Parang" produced from initial value: angle = $50^0$, diameter = 0.5, length = 7 and number of iteration (n) = 5. For direction, RIGHT: Rotate (angle, Y-axis);LEFT: Rotate (-angle*2, Y-axis);UP: Rotate (-angle*2, X-axis and Z-axis);DOWN: Rotate (angle*2, Y-axis);

For the next model as shown in Figure 5 namely 3D model of ring jewelry of "Kendari Batik Pamiluto", the changes made by changing the initial value i.e. angle = $45^0$, diameter = 1, length = 5 and number of iteration (n) = 5.

Furthermore, the model as shown in Figure 6, namely 3D model of ring jewelry of "Kendari Batik Sidomukti", changes were made to change the initial value only. The changes made by changing the initial value i.e. angle = $45^0$, diameter = 0.5, length = 7 and number of iteration (n) = 6.

Finally the next model as shown in Figure 7 is the3D model of ring jewelry of "Kendari Batik Ranting Cirebon", the change is also done simply by changing the initial value only i.e. angle = $100^0$, diameter = 0.3, length = 13 and number of iteration (n) = 3.

Of the four examples of modeling results above, can produce a variety of models with large numbers of more than 340 models. To generate the proposed method only requires a period of 6 minutes. Changes in the value of turning angle and rotary axes can yield attractive model. If only use to the combination of Right-Left-Up-Down(LRUD) it will produce 340 models.The calculation result is obtained from the calculation $4^4+4^3+4^2+4^1$ = 340. In this case 4 factorial arrangement obtained from each of four combinations can be filled by any one of 4 directions Right-Left-Up-Down. The result of the combination of the top, bottom, left and right it will get as many as 340 variations of fractal shapes. This does not include the added variety and number of iterative way. There will be more than 340 variations of shapes that can be created with this algorithm.

## 6. Conclusion

Nowadays there ismuch3D graphic software. Now it is possible to produce new application using the programming techniques, which enjoy high graphic quality and charm. So it is possible to create geometric and compound shapes in programming environments using IFS that is method of constructing fractal.The 3D modeling of jewelry ornament will be tested using Windows Operating System,OpenGL and C programming. This research has produced more than 340 of rings and jewelry designs unique traditional and modern. This research has produced more than 340 of rings and jewelry designs unique traditional and modern nuances. To generate the proposed method only requires a period of 6 minutes.

## References

[1] Suyoto, Computer Graphic with Visual C ++ and OpenGL v.6. (in Bahasa), Yogyakarta: Gava Media, 2003.

[2] Suyoto, "Computer Graphic with J2ME? (in Bahasa)," Jurnal AiTI, II (2), 2005.

[3] Suyoto, "Fractal Applications on Mobile Phones with J2ME? (in Bahasa)," Jurnal Teknologi Industri, X (2), 2006.

[4] LPPM, "Master Plan Research of University of Atma Jaya Yogyakarta Year 2010-2014. (in Bahasa)," Yogyakarta, 2009.

[5] Y. Yan and L. Kunhui, "3D Visual Design for Mobile Search Result on 3G Mobile Phone," Xiamen University, Xiamen 361005, Fujian, China, 2010.

[6] R. Yulianto, H. Moch. and H. P. Mauridhi, "Fractal Based on Noise for Batik Coloring using Normal Gaussian Method," The Journal for Technology and Science, XXIII (1), pp. 34-40, 2012.

[7] Y. Guermond, D. Delahaye, E. Dubos-Paillard and P. Langlois, "From modelling to experiment," GeoJournal, LIX (3), p. 171, 2004.

[8] I. Stephen, Y. Zhou, D. Walterhouse, GregTaborn, G. Landini and PhilipIannaccone, "Three Dimensional Visualization and Fractal Analysis of Mosaic Patches in Rat Chimeras: Cell Assortment in Liver, Adrenal Cortex and Cornea," plosone, VII (2), 2012.

[9] G. Vincenzo, A. Guaccio, P. A. Netti and L. Ambrosio, "Image processing and fractal box counting: user-assisted method for multi-scale porous scaffold characterization," J Mater Sci: Mater Med, XX1, pp. 3109–3118, 2010.

[10] S. M. Ricardo and A. T. C. Pereira, "Fractal Shape," in Nexus 2010: Relationships Between Architecture and Mathematics, Porto, 2010.

[11] Y. Hariadi, M. Lukman and a. A. H. Destiarmand, "Batik Fractal: Marriage of Art and Science," Bandung, Indonesia, 2010.

[12] Y. Li, C.-J. Hu1 and X. Yao, "Innovative Batik Design with an Interactive Evolutionary Art System," Journal Of Computer Science and Technoogy, XXIV (6), pp. 1035–1047, 2009.

[13] C.-H. Lin, J.-L. Chen and C. Y. Tseng, "Optical sensor measurement and biometric-based fractal pattern classifier for fingerprint recognition," Expert Systems with Applications, XXXVIII (5), pp. 5081-5089, 2011.

[14] W.-L. Lee and K.-S. Hsieh, "A robust algorithm for the fractal dimension of images and its applications to the classification of natural images and ultrasonic liver images," Signal Processing, XC (6), pp. 1894-1904, 2010.

[15] F. Mendoza, N. A. Valous, P. Allen, T. A. Kenny, P. Ward and D.-W. Sun, "Analysis and classification of commercial ham slice images using directional fractal dimension features," Meat Science, LXXXI (2), pp. 313-320, 2009.

[16] J. C. Germain and J. M. Aguilera, "Identifying industrial food foam structures by 2D surface image analysis and pattern recognition," Journal of Food Engineering, CXI (2), pp. 440-448, 2012.

[17] S. Ben Moussa, A. Zahour, A. Benabdelhafid and A. M. Alimi, "New features using fractal multi-dimensions for generalized Arabic font recognition," Pattern

Recognition Letters, XXXI (5), pp. 361-371, 2010.

[18] R. Quevedo, M. Jaramillo, O. Díaz, F. Pedreschi and J. M. Aguilera, "Quantification of enzymatic browning in apple slices applying the fractal texture Fourier image," Journal of Food Engineering, XCV (2), p. 28, 2009.

[19] Y. Tao, E. C. M. Lam and Y. Y. Tang, "A Combination of Fractal and Wavelet for Feature Extraction," International Journal of Pattern Recognition & Artificial Intelligence, XV (8), pp. 2777, 2001.

[20] Y. Q. Chen and G. Bi, "On Texture Classification Using Fractal Dimension," International Journal of Pattern Recognition & Artificial Intelligence, XIII (6), pp. 929, 1999.

[21] A. R. Backes, D. Casanova and O. M. Bruno, "Plant Leaf Identification Based On Volumetric Fractal Dimension," International Journal of Pattern Recognition & Artificial Intelligence, XXIII (6), pp. 1145-1160, 2009.

[22] C. S. Calude and J. Lewis, "Is there a universal image generator?," Applied Mathematics & Computation, vol. CCXVIII (16), pp. 8151-8159, 2012.

[23] J. Courtial and M. J. Padgett, "Generation of self-reproducing fractal patterns using a multiple imaging system with feedback," Journal of Modern Optics, vol. XLVII (8), pp. 1469-1474, 2000.

[24] K. Chung and H. Ma, "Automatic generation of aesthetic patterns on fractal tilings by means of dynamical systems," Chaos, Solitons & Fractals, XXIV (4), pp. 1145-1158, 2005.

[25] K. Chung, H. Chan and B. Wang, "Automatic generation of nonperiodic patterns from dynamical systems," Chaos, Solitons & Fractals, XIX (5), pp. 177, 2004.

[26] A. S. Aribowo, "The Model of Searching Digital Image on Database Image using the Approach of Color Pattern Proximity Calculation.," in Seminar Nasional Informatika, Yogyakarta, 2009.

[27] L. Sumarno and E. Harjanti, "Pengenalan Ucapan Dengan Jaringan Saraf Tiruan Kohonen," Jurnal SIGMA, Program Studi Teknik Elektro, Fakultas Teknik Universitas Sanata Dharma, VIII (2), pp. 117-125, 2005.

[28] Samsuyardi, "Pengidentifikasian Pembuat Tulisan Tangan Dengan Pengenalan Pola Biomimetik," Jurnal Generik Fakultas Ilmu Komputer Universitas Sriwijaya, IV (2), pp. 31-33, 2009.

[29] F. S. Gharehchopogh, I. Maleki and S. Sadouni, "Analysis of the Fractal Koch Method in Computer Games Development," International Journal of Computer Graphics & Animation (IJCGA), IV (1), January 2014.

## Author Profile

**Suyoto** is Professor in Department of Informatics Engineering at University of Atma Jaya Yogyakarta, Indonesia. He has more than fifteen years of teaching experience. He received his Ph.D. from the National University of Malaysia, Malaysia. His research interests are multimedia, computer graphics, visualization, mobile application and artificial intelligence.

**Thomas Suselo** is lecturer in Department of Informatics Engineering at University of Atma Jaya Yogyakarta, Indonesia. He has more than ten years of teaching experience. He received his M.Eng. from of Institute of Technology Bandung (ITB), Indonesia. His research interests are multimedia, mobile application and e/m Business.

**B. Yudi Dwiandiyanta** is lecturer in Department of Informatics Engineering at University of Atma Jaya Yogyakarta, Indonesia. He has more than ten years of teaching experience. He received his M.Eng. from the University of Gadjah Mada, Yogyakarta, Indonesia. His research interests are multimedia, mobile application and Image Processing.