

Reproducing Paintings with Mondrian's Style During the Period of 1921~1933

Junewei Chen*

ABSTRACT

Piet Mondrian was one of the leaders of the De Stijl artistic movements. His paintings were representative of Neoplasticism and affected deeply European artistic creation at that time. In this paper, Mondrian's painting style during the period of 1921~1933 was studied. By analyzing the ideas behind his creations, decomposing his sketches and consulting to critique literatures by specialists, this study tried to extract the rules used in Mondrian's paintings that expressed his personal views. According to the findings, this study speculated that Mondrian's painting process in the period of 1921-33 could generally be divided into three stages. Firstly, vertical and horizontal lines were arranged, then, three primary colors plus black were disposed, and lastly, these two parts were further harmonized. With a demonstrating program utilizing the rules compiled, a painting of Mondrian's style during 1921-33 can be readily generated within no time.

Key words: Piet Mondrian, form generation, style computing

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Introduction

Neo-plasticism, originated from Mondrian's abstraction, played an important role in the twentieth-century art. Nevertheless, the importance of Mondrian's works to the art history of the twentieth-century has been underestimated (Bois, 1994). To make it practicable to preserve the style of Mondrian's paintings by computing, this paper chose 38 paintings (Figure 1, Exclude the sixteen diamond-shaped paintings) finished during the period 1921-1933 that were best known as Mondrian's abstract style to extract the stylistic characteristics for later use in the process of style reappearance. These paintings were also the only creations that had been preserved (Fauchereau, 1994).

The Renaissance theorist Leon Battista Alberti, in his book 'On Painting', pointed out that outline and color were the two most essential constituents of paintings. Outlining, setting boundaries of regions with lines, is the first step in painting. Coloring, filling in outlined regions with colors is the final step in painting. This indicated that although drawing and painting may be considered separately, outline and color were often integrated in a single composition, either during the process of composition or in the finished composition itself (Stiny, 1980; Knight, 1989; Alberti, 1996). These statements revealed several important facts. First, the basic elements either in a painting or in a drawing are the lines and the colors. Second, the lines and the colors placed either in the same painting or in the same drawing must be restricted by some relationships. In accordance with these viewpoints, this paper decomposed the style of Mondrian's compositions in the period 1921-1933 to extract the common characteristics among these paintings. After being able to describe these

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common features clearly, it becomes possible to preserve the style of Mondrian's compositions by computational techniques. The concept of form generation by computing will be released (Chen, 1995; Kalay, 1989; Krishnamuti, 1980, 1993)

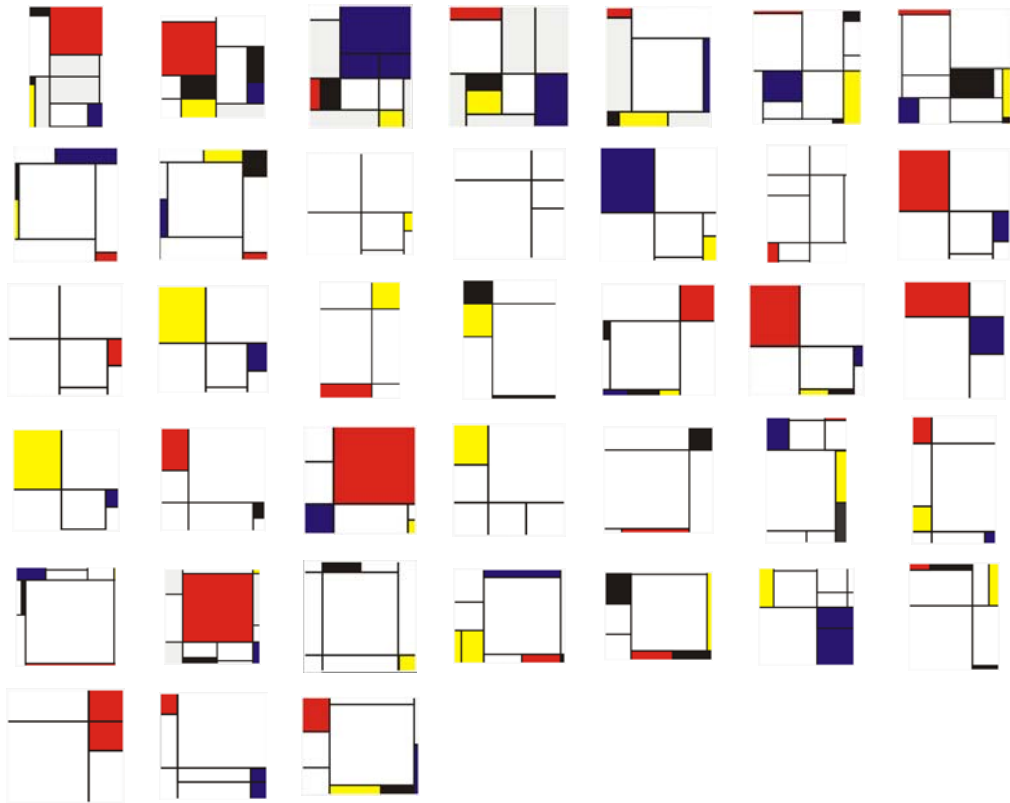


Figure 1 The 38 paintings that were collected to study

Common Characteristics Found in Mondrian's Paintings in the Period of 1921-1933

The Width to Height Ratios

With the 38 collected compositions in the period of 1921-1933, this study found that Mondrian used many different sizes of canvas to paint. To sort out the regularity of the canvases sizes that Mondrian often used to paint, this study examined the width to height ratio of every collected painting one by one. It was found that the width to

height ratio among the 38 collected compositions could be roughly classify into seven groups, such as 1:0.6, 1:0.7, 1:0.8, 1:0.9, 1:1, 1:1.5, and 1:1.6. The number of the compositions with each kind of situation about the canvas width : height ratio is presented in Table 1.

Table 1 The number of the compositions with each kind of situation about the canvas width : height ratio

The situation about the canvas width : height ratio	Number	The situation about the canvas width : height ratio	Number
Canvas width : height ratio = 1 : 0. 6	1	Canvas width : height ratio = 1 : 1	23
Canvas width : height ratio = 1 : 0. 7	5	Canvas width : height ratio = 1 : 1. 5	1
Canvas width : height ratio = 1 : 0. 8	4	Canvas width : height ratio = 1 : 1. 6	2
Canvas width : height ratio = 1 : 0. 9	2	Total	38

The Basic Elements Used

According to Mondrian's descriptions of his painting style, the basic elements in his compositions can be classified into lines, both vertical and horizontal, and color regions, presented by red, yellow, blue, black and gray. Particularly, this study found that both the vertical lines and the horizontal lines in those paintings in the period 1921-1933 could be further classified into: through lines, one-side lines and middle lines. The through lines mean those having both end points located at picture's two edges (Figures 2a and 2b). The middle lines are those having no end point located at any one edge of the picture (Figures 2c and 2d). The one-side lines are those having only one end point located at one edge of the picture (Figures 2e, 2f, 2g, 2h, 2i and 2j).

This study also found that the basic colors that Mondrian frequently used could be classified into major colors and minor colors. The major colors are those frequently used by Mondrian and can easily be seen by viewers. These colors include red, yellow, blue and black. The minor colors, not used so frequently by Mondrian nor can be seen so often by viewers, include gray, light-blue and gray-blue. Because the difference between the lightness of the minor colors and the white canvas is too hard for people to distinguish, it seems that the visual impact of the minor colors is far less than that of the major colors. Therefore, this study paid more attention to major colors than minor

colors.

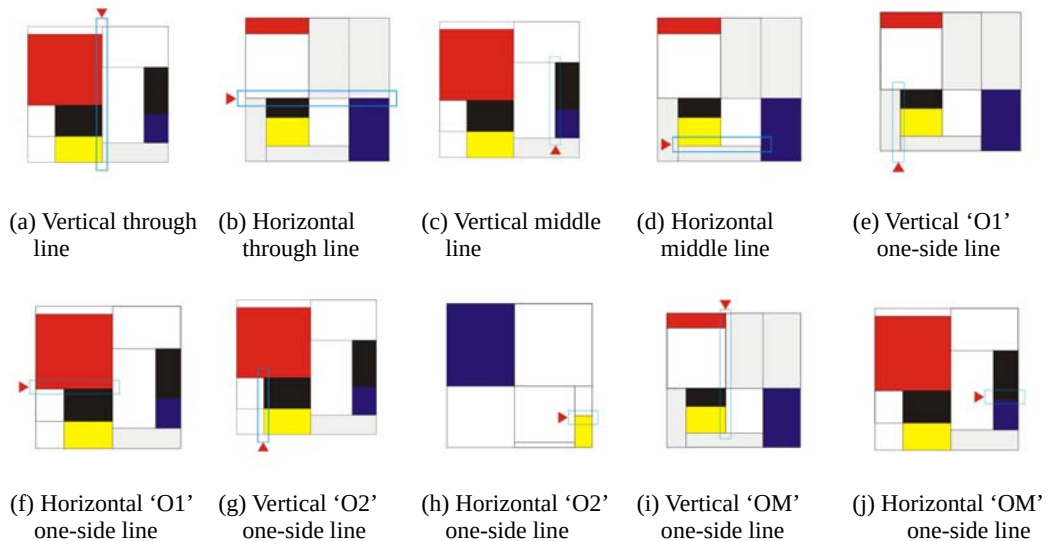


Figure 2 Three types of lines in both vertical and horizontal directions

*O1: One-side line's one end point is at the through line; O2: One-side line's one end point is at the 'O1' one-side line; OM: One-side line's one end point is at the middle line

The Number of Lines Used

By counting the number of three kinds of lines in every painting among the 38 compositions in the period 1921-1933, this study found the following facts.

First, the number of through lines in both vertical and horizontal are no more than two. In all situations, this study found that paintings without vertical through line have at least one horizontal through line, and vice versa. The number of the compositions with this kind of situation about the amount of the through lines is presented in Table2.

Second, the number of the 'O1' vertical one-side lines (Figure 2e) whose one end point is at the horizontal through line as well as the number of the 'O1' horizontal one-side lines (Figure 2f) whose one end point is at the vertical through line is no more than 4. Besides, the number of the 'O2' vertical one-side lines (Figure 2g) whose one end point is at the 'O1' horizontal one-side line as well as the number of the 'O2' horizontal one-side lines (Figure 2h) whose one end point is at the 'O1' vertical one-side line is no more than 2. And the number of the 'OM' vertical one-side lines

(Figure 2i) whose one end point is at the horizontal middle line as well as the number of the 'OM' horizontal one-side lines (Figure 2j) whose one end point is at the vertical middle line is no more than 1. The number of the compositions with this kind of situation about the amount of the one-side lines is presented in Table2.

Third, both the number of the vertical middle lines and the number of the horizontal middle lines are no more than 2. The number of the compositions with this kind of situation about the amount of the middle lines is presented in Table2.

Table 2 The number of the compositions with each kind of situation about the amount of three kinds of lines

Category	The situation about the amount of the lines	Number	Category	The situation about the amount of the lines	Number
Through line	With two vertical through lines	2	One-side line	With none vertical 'O1' one-side line	1
	With one vertical through line	31		With four horizontal 'O1' one-side lines	2
	With none vertical through line	5		With three horizontal 'O1' one-side lines	5
	With two horizontal through lines	7		With two horizontal 'O1' one-side lines	5
	With one horizontal through line	25		With one horizontal 'O1' one-side lines	14
	With none horizontal through line	6		With none horizontal 'O1' one-side lines	12
Middle line	With two vertical middle lines	2		With two vertical 'O2' one-side lines	5
	With one vertical middle line	5		With one vertical 'O2' one-side lines	5
	With none vertical middle line	31		With none vertical 'O2' one-side line	28
	With two horizontal middle lines	3		With two horizontal 'O2' one-side line	4
	With one horizontal middle line	15		With one horizontal 'O2' one-side line	13
	With none horizontal middle line	20		With none horizontal 'O2' one-side line	21
One-side line	With four vertical 'O1' one-side lines	1		With one vertical 'OM' one-side line	3
	With three vertical 'O1' one-side lines	4		With none vertical 'OM' one-side line	35
	With two vertical 'O1' one-side lines	10		With one horizontal 'OM' one-side line	4
	With one vertical 'O1' one-side line	22		With none horizontal 'OM' one-side line	34

*O1 : One-side line's starting point is at the through line ; O2 : One-side line's starting point is at the first extended one-side line ; O3 : One-side line's starting point is at the second extended one-side line

The Regular Pattern of the Line Positions

To realize the regular pattern of the line positions shown in Mondrian paintings, this study designed a square grid system with 16 divisions on both sides (Figure 3). While the researcher must check the positions of each line, what he does is to scale down the long side of the painting to be equal to the width of the grid (Figure 4). By checking all the lines of both directions in every painting, this study found the following facts.

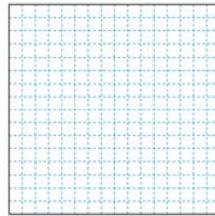


Figure 3 A grid system with 16 divisions on both sides

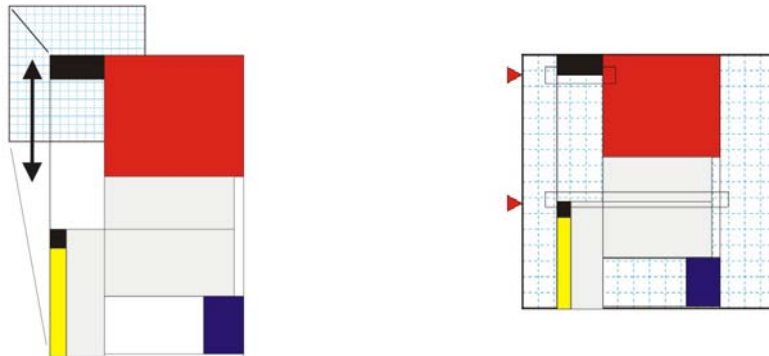


Figure 4 Measuring the line positions both in vertical and horizontal directions

First, for vertical through lines, if one is placed at the left half of a painting, its position is neither more than seven sixteenths of the width of the painting nor less than one sixteenth of that (Figure 5a). If a vertical through line is placed at the right half of a painting, its position is neither more than fifteen sixteenths of the width of the painting nor less than nine sixteenths of that (Figure 5b). This means that the vertical through lines would never appear at the center region of a painting. This situation is

also true for the horizontal through lines. In other words, if a horizontal through line is placed at the upper half of a painting, its position is neither more than seven sixteenths of the height of the painting nor less than one sixteenth of that (Figure 5c). If a horizontal through line is placed at the lower half of a painting, its position is neither more than fifteen sixteenths of the height of the painting nor less than nine sixteenths of that. This means that the horizontal through lines would not appear at the center region of a painting (Figure 5d).

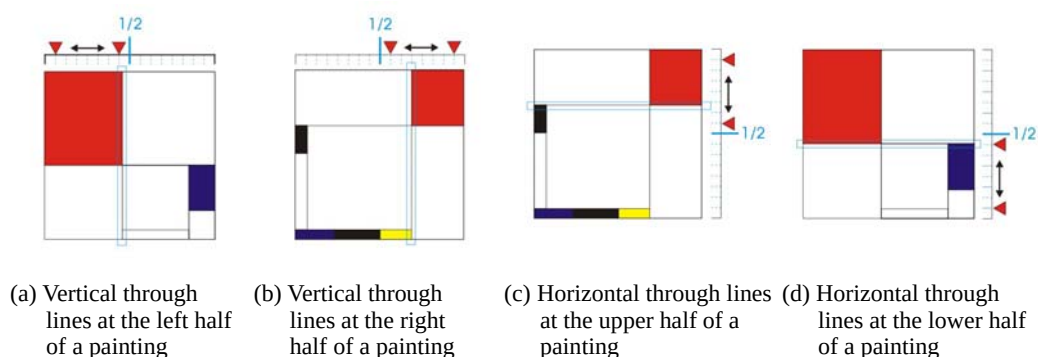
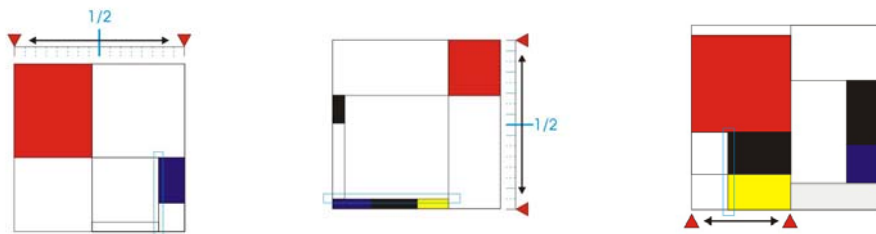


Figure 5 The range of the positions of the through lines

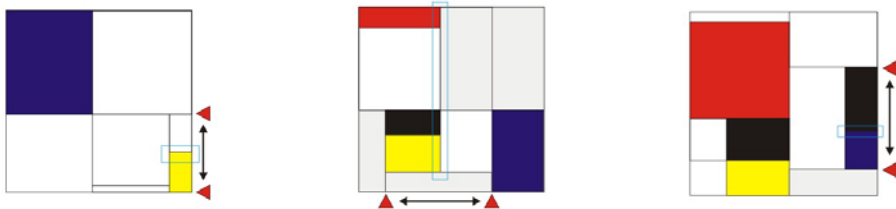
Second, it seems that neither the positions of 'O1' vertical one-side lines nor that of 'O1' horizontal one-side lines are restricted (Figures 6a and 6b). This means that both of 'O1' vertical one-side lines and 'O1' horizontal one-side lines can be placed freely in their respective area. Nevertheless, both the positions of 'O2' one-side lines and that of 'OM' one-side lines are limited in one way or the other. For example, the position of an 'O2' vertical/horizontal one-side line must be limited horizontally/vertically in the range between the two end points of the 'O1' horizontal/vertical one-side line it connected to (Figures 6c and 6d). In the same manner, the position of an 'OM' vertical/horizontal one-side line must be limited horizontally/vertically in the range between the two end points of the horizontal/vertical middle line it connected to (Figures 6e and 6f).

Third, this study also found that the position of a vertical middle line is limited in the range from the left edge of a painting to one sixteenth of the width of that painting if it is placed at the left half of a painting (Figure 7a). If a vertical middle line is placed at the right half of a painting, its position will be limited in the range from the fifteen

sixteenths of the width of a painting to the right edge of that painting (Figure 7b). The situation is similar to the horizontal middle lines. In other words, if the horizontal middle line is placed at the upper/lower half of a painting, the position of the horizontal middle line is limited in the range from the top/bottom edge of the painting to one sixteenth/fifteen sixteenths of the height of that painting (Figures 7c and 7d). In short, both the vertical middle lines and the horizontal middle lines are only placed near the edge of a painting.

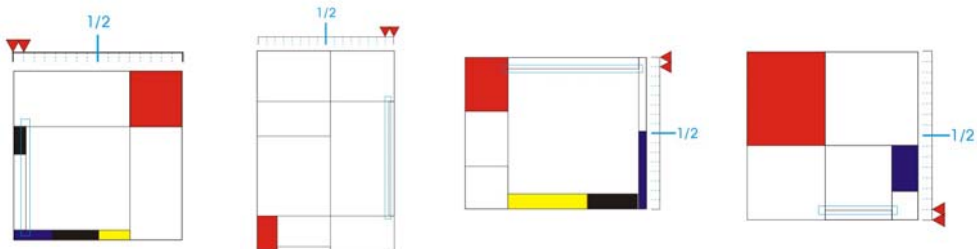


(a) Vertical 'O1' one-side line (b) Horizontal 'O1' one-side line (c) Vertical 'O2' one-side line



(d) Horizontal 'O2' one-side line (e) Vertical 'OM' one-side line (f) Horizontal 'OM' one-side line

Figure 6 The range of the positions of the one-side lines



(a) Middle lines at the left half of a painting (b) Middle lines at the right half of a painting (c) Middle lines at the upper half of a painting (d) Middle lines at the lower half of a painting

Figure 7 The range of the positions of the middle lines

The Number of Colors Used

In much the same way as counting the number of lines, this study counted the number of colors as well as the frequency of each color appeared. The study found that the number of the filled areas with colors like red, yellow, blue, and black, is no more than five in total.

As for the frequency of each color appeared, the study found that the major colors such as red, yellow and blue, appeared only once at most in the total 38 collected paintings. And the minor color like black, appeared no more than twice in the total 38 collected paintings.

The number of the compositions with each kind of situation about the amount of the filled areas is presented in Table 3.

Table 3 The number of the compositions with each kind of situation about the amount of the filled areas

The situation about the amount of filled areas	Number	The situation about the amount of filled areas	Number
The composition with five color planes	4	The composition with two color planes	10
The composition with four color planes	14	The composition with one color planes	5
The composition with three color planes	4	The composition with none color planes	1

The Locations of Colored Areas

By applying the same concept for measuring the positions of lines, this study used a grid system to realize which locations were most frequently arranged to accommodate these colored areas by Mondrian. The study found that the color areas were always placed on the periphery and limited one for each side of a painting with a few exceptions such as paintings: TABLEAU NO. III (Mondrian, 1921), TABLEAU I (Mondrian, 1921), TABLEAU II (Mondrian, 1921), and Composition with Large Red Plan, Gray-Blue, Yellow, Black, and Blue (Mondrian, 1922).

The Relationships Between the Colored Areas and the Lines

The positions of the colored areas were correlative with the lines. For example, there was usually one colored area placed at the intersection of one vertical through line

and one horizontal through line. This means that the colored area would never appeared when there is only one vertical through line or only one horizontal line appeared.

Besides, there was always a colored area placed with at the intersection of one vertical through line and one horizontal one-side line or at the intersection of one horizontal through line and one vertical one-side line. This means that such a colored area would not exist if only a vertical through line without intersecting any horizontal one-side line or if only a horizontal through line without intersecting any vertical one-side line.

Finally, this study also found that a colored area always appeared with one vertical/horizontal through line, one vertical/horizontal one-side line and one horizontal/vertical middle line. This means that without the combination of a vertical/horizontal through line, a vertical/horizontal one-side line and a horizontal/vertical middle line at the same time, this colored area would not exit.

The number of the compositions with each kind of situation about the relationship between the color planes and the lines is presented in Table 4.

Table 4 The number of the compositions with each kind of situation about the relationship between the color planes and the lines

Relationship between the color planes and the lines	Number	Relationship between the color planes and the lines	Number
Color plane with through line and one-side line	20	Color plane with vertical through line, vertical one-side line and horizontal line	6
Color plane with vertical through line and horizontal one-side line	14	Color plane with horizontal through line, horizontal one-side line and vertical line	7
Color plane with horizontal through line and vertical one-side line	19		

Reproducing Paintings With Mondrian's Style

The Axiom of Reproducing Paintings with Mondrian's Style

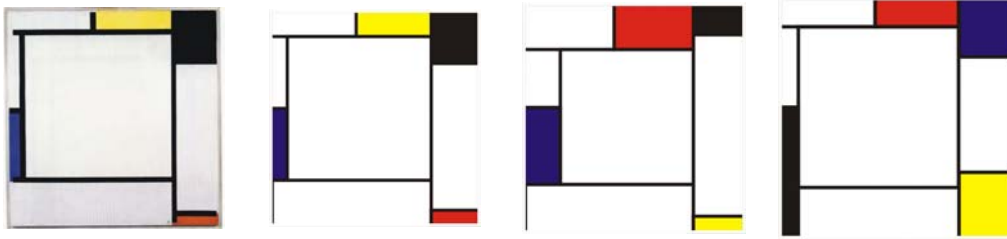
After thoroughly extracting the characteristics of the 38 collected paintings in the period of 1921-1933, then, converting them into generative rules, this study programmed these rules into Visual Basic language. By converting the characteristics of Mondrian's style into a program, the purpose of preserving Mondrian's style by

computing can be achieved.

In this program, one of those rules describes a particular extracting characteristic. Every rule sets a particular range to permit a user to create the paintings with the same style (Table 5, Take the vertical through line as example). In other words, three kinds of condition could be produced by using the program. These are the same painting with the original, the similar painting with the original and the new painting with the same style. For example, the user can make the same painting (Figure 8b) with the original by placing the lines and colors according to the original painting (Figure 8a). He can also make the similar painting (Figure 8c) with the original by moving the lines to the near position and changing the colors. Finally, the user can make a new painting (Figure 8d) with the same style by free way.

Table 5 The rule and the code of controlling the position of the vertical through line

Rule	if $x1 < 1/2 \times \text{width}$ (of canvas) then $1/16 \times \text{width}$ (of canvas) $< x1 < 7/16 \times \text{width}$ (of canvas) ($x1$: coordinate of the location of the vertical through line in vertical direction of the canvas) .
Code	Dim Line1(i).X1 = HScroll1(i).Value , Line1(i).X2 = HScroll1(i).Value If Line1(i).X1 $> 7 * \text{Picture1.Width} / 16$ And Line1(i).X1 $< 8 * \text{Picture1.Width} / 16$ Then Line1(i).X1 = $7 * \text{Picture1.Width} / 16$, Line1(i).X2 = $7 * \text{Picture1.Width} / 16$ End If
Rule	If $x1 \geq 1/2 \times \text{width}$ (of canvas) then $9/16 \times \text{width}$ (of canvas) $< x1 < 15/16 \times \text{width}$ (of canvas) .
Code	Dim Line1(i).X1 = HScroll1(i).Value , Line1(i).X2 = HScroll1(i).Value If Line1(i).X1 $\geq 8 * \text{Picture1.Width} / 16$ And Line1(i).X1 $< 9 * \text{Picture1.Width} / 16$ Then Line1(i).X1 = $9 * \text{Picture1.Width} / 16$, Line1(i).X2 = $9 * \text{Picture1.Width} / 16$ End If
Rule	if $y1 < 1/2 \times \text{height}$ (of canvas) then $1/16 \times \text{height}$ (of canvas) $< y1 < 7/16 \times \text{height}$ (of canvas) ($y1$: coordinate of the location of the horizontal through line in horizontal direction of the canvas) .
Code	Dim Line1(i + 2).Y1 = HScroll1(i + 2).Value , Line1(i + 2).Y2 = HScroll1(i + 2).Value If Line1(i + 2).Y1 $> 7 * \text{Picture1.Height} / 16$ And Line1(i + 2).Y1 $< 8 * \text{Picture1.Height} / 16$ Then Line1(i + 2).Y1 = $7 * \text{Picture1.Height} / 16$, Line1(i + 2).Y2 = $7 * \text{Picture1.Height} / 16$ End If
Rule	If $y1 \geq 1/2 \times \text{height}$ (of canvas) then $9/16 \times \text{height}$ (of canvas) $< y1 < 15/16 \times \text{height}$ (of canvas)
Code	Dim Line1(i + 2).Y1 = HScroll1(i + 2).Value , Line1(i + 2).Y2 = HScroll1(i + 2).Value If Line1(i + 2).Y1 $\geq 8 * \text{Picture1.Height} / 16$ And Line1(i + 2).Y1 $< 9 * \text{Picture1.Height} / 16$ Then Line1(i + 2).Y1 = $9 * \text{Picture1.Height} / 16$, Line1(i + 2).Y2 = $9 * \text{Picture1.Height} / 16$ End If



(a) The original

(b) The same

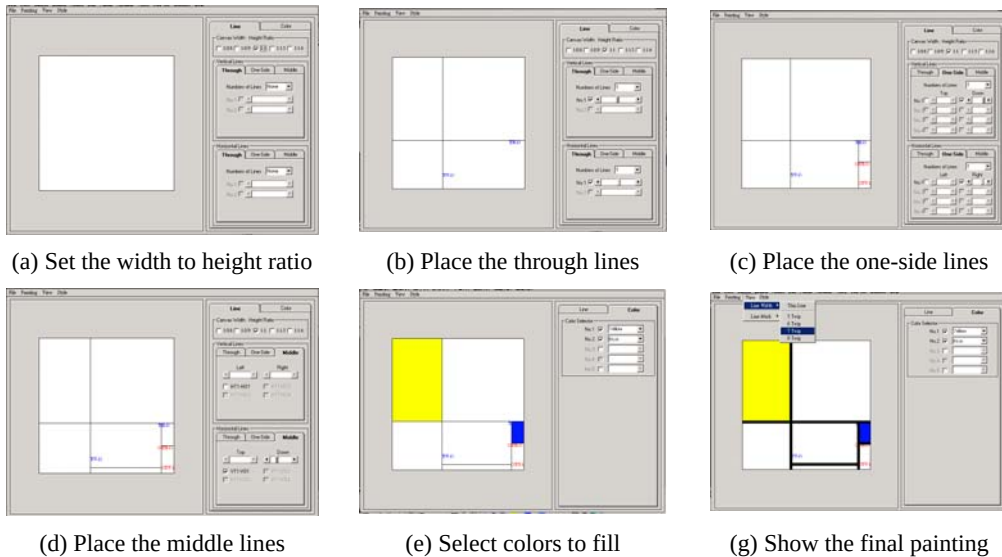
(c) The similar

(d) The new

Figure 8 Three kinds of condition could produce by using Mondrian's style program.

Imitating the Existing Painting

The procedure of imitating Mondrian's painting, MPOSITION NO.II; Composition with Yellow and Blue, is shown in Figure 9. This indicated the condition of making the same painting with the original.



(a) Set the width to height ratio

(b) Place the through lines

(c) Place the one-side lines

(d) Place the middle lines

(e) Select colors to fill

(g) Show the final painting

Figure 9 The procedure of imitating Mondrian's painting

Creating a New Painting with Mondrian's Style

The procedure of reproducing paintings with Mondrian's style is shown in Figure

10. This indicated the condition of making a new painting with the same style.

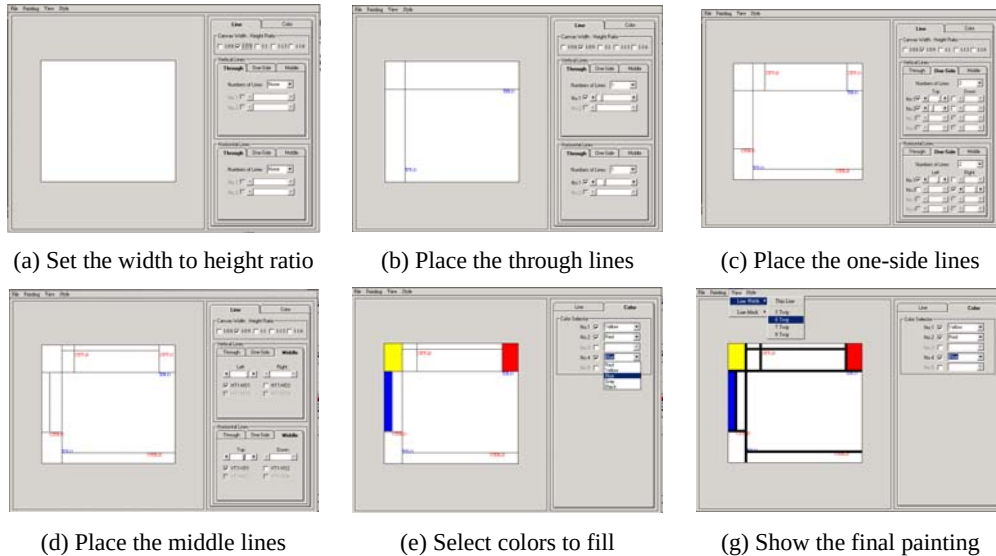


Figure 10 The procedure of reproducing Mondrian's painting

Conclusions and Suggestions

By analyzing the stylistic characteristics of Mondrian's composition completely and then converting them into a piece of program, this study has demonstrated the possibility and practicability of preserving someone's drawing style by computational techniques. In the near future, hopefully three-dimensional art works can also be preserved by similar techniques.

Acknowledgement

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再現蒙德里安 1921~1933 時期 之繪畫風格

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摘 要

蒙德里安是 De Stijl 風格運動之重要的領導人物之一，他的作品被視為是新造型主義（Neoplasticism）的代表且影響該時期歐洲之藝術史深遠。本文主要以蒙德里安於 1921~1933 期間之創作為探討對象，期望藉由其創作概念之分析、作品草稿之解構與相關評述文章，整理出代表其個人創作觀點的繪畫風格。研究發現，蒙德里安之創作過程可分三階段，分別為初步的放置垂直線與水平線，接著為放置三基本色，最後再進一步調整兩者。而本文最後將藉由規則之程式化之實作以呈現蒙德里安於 1921~1933 期間創作之再現的可行性。

關鍵字：蒙德里安、型態建構、風格演算

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