Guilloche Pattern for Security in Confidential Documents

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Abstract

Security pattern design is one of the most important techniques of securing confidential documents. A well designed security pattern should be difficult to counterfeit in any way. Therefore it can be used in printed security documents, such as banknotes, passports and certificates, etc. In this paper, algorithms are designed for generating guilloche patterns. It proposes a novel scheme of security pattern design. The practical pattern examples are presented, and some other applications of the novel method are also discussed currently, this methodologies are used due to its high efficiency. Guilloches are used in identity certificates, auto registration certificates, fiscal marks, policy forms and licenses, travel documents, tickets, diplomas and other certificates that often become the object of forgery and falsification.

1. Introduction

Documents protection from forgeries has always been one of the major tasks in any society. A document is a material object assigned and created by a man in a method that its information can be transmitted in time and space. The foundation of the protected printing products composition must be guilloche images that are difficult combinations of thin and continuous lines which have a difficult structure and typical spacing of 1-2 mm.
Guilloche provides the very high degree of securities protection. Fine-line Guilloche patterns with hidden micro-text are aimed at foiling counterfeiters and micro-printing of text and miniature graphic elements are also difficult to duplicate. Guilloche composition cannot be forged as they are framed as very small thickness of lines and the constant change of curvature of every line create insuperable obstacles to a block with an insufficient for today discrimination capacity. It is difficult to scan even monochrome guilloche elements, as quite often they contain periodic elements that repeat themselves and require the enormous memory arrays of the PC, and that hampers the work of computer

Security printing deals with printed document, certificates, legal documents and all kind certificates given for authenticity, ownership or educational achievements.

There are many steps and different features involved to secure the document.

The guilloche images are difficult combinations of thin and continuous lines which have a difficult structure and typical spacing of 1-2 mm or any suitable measurement. Basic Bases can be the followings types for designing: a line, an ellipse, a polygon, a rectangle, a poly-line, an ellipse's etc. with the combination of basic bases and color these are used to design various types of complex guilloche patterns. Also these patterns become intricate when color combinations are added to it.

2. Related Work

In this paper [1], it is discussed about protecting document images from fraud by Periodic patterns such as holograms, watermarks or guilloche elements and these patterns are processed using automatic document processing system. of periodic pattern detection on document images which use discrete Fourier transform. This paper propose a method of periodic pattern detection on document images which can be used for various periodic pattern structures implying their nature is known for the given document type. The method will be illustrated and experimentally tested for Russian citizen passport images. Steps followed in detecting pattern are Image cropping, Image downscale and preprocessing. The implementation is very simple but has yet shown good experimental results even almost without any parameter tuning.

In Paper [2] is about MECCA 2000 System the next generation of Amgraf's MECCA III - the world's premier business forms composition system. The MECCA 2000 software offers graphic designers a comprehensive suite of tools to create multi-color, multi-part forms with graduated screens, borders and pantographs, scanned logos, barcodes, and fine typography. The software includes trapping, flexographic distortion, and a unique step-and-repeat feature. Graphical effects are easy to create but virtually impossible to duplicate. There are four classes of security technologies used to protect a document. The safest document is one that includes all of these four technologies in its makeup. This paper also involves the

creation of security graphics such as backgrounds, the appearance of microprinting, artificial watermarks, thermo chromatic ink, foil stamps, and other overt features. Warning bands are common on checks, stocks, and titles, because they alert the receiver of the document.

In [3], This document gives information about Document security, security feature classification according to application criteria, security features involved at printing technique There are many features which used for security and they get involved in different steps production, i.e. security involved at substrate level when it is manufactured, the designing elements which are involved in document for security, the printing processes and special applications used and at last different post press special applications used. There are different aspects where the security is involved as Paper Substrates security features are according to the composition of paper, it's feel, sound, tint, gloss, watermark included in it at a time of manufacturing or after manufacturing using special watermark generating Chemicals.

3. Proposed Work

Designing algorithms for create guilloche patterns. Guilloche patterns are difficult to forge as these are periodic pattern of thin line spacing. These patterns are so complex such that there is less chance of forging the data on which patterns are applied. Anti aliasing is also done for clear view of images. These patterns are created using basic structure. These basic structures are formed with the concepts of coordinate geometry. The images formed can be viewed clearly without overlapping. With the help of Algorithms these patterns are obtained it shows clear line spacing between the patterns, also the color combination increase the degree of security. Color combination are helpful in enhancing the complexity so as to make them secure.

This is discussed here how we have created the guilloche patterns with the combination of basic structures such as a point, a line, a circle, an ellipse, a star which can be pinpoint or a convex and a concave star. These are used to design various types of complex guilloche pattern such as floral pattern and flower in flower pattern, polygon in ellipse, polygon in circle etc.

All the patterns are designed using MATLAB.
3.1 POLYGON (with number of edges from 3 to 10)

This algorithm gives various polygons with edges 3 to 10 (Triangle, Square, Pentagon, hexagon etc.) .

1) Defining the height and width for the frame in which the design will be displayed.
2) Initialize and assign value to get the n umber of points.

$nPoints = 40;$

3) Initialize and apply values to radius

$ra = 100;$
$rb = 200;$

4) Initialize interval = 20.
5) Apply loop for obtaining the side of polygon noSides = 3:10
6) Apply loop for angle so as to rotate an single polygon in circular fashion.

$$angle = 0: interval : 360;$$

7) Save the image.

3.2 COMBINATION OF CONCAVE AND CONVEX STAR STARS

The patterns obtained by this combination with the implementation in the function defined in algorithm. In the function phase difference of +90 and -90 is defined. So as to obtaion concave and convex star.

1) Initialize height and width for the frame in which the design will be displayed.

2) Initialize an matrix
$$I = uint8(ones(height, width, 3) * 255)$$

3) Initialize and applying values to inner and outer radius colour and npoints.

$rInner = 100$
$rOuter = 150$
$color = [0\ 0\ 255]$
$nPoints = 40$

4) With the help of following functions patterns are obtained.

$$function[I] =$$
$$drawInImage\_StarConcave(\ I, xc, yc, rOuter, rInner, color, nPoints\ )$$

3.3 COMBINATION OF FLOWERS

The algorithm contain complex ellipse pattern or flower pattern and that single ellipse pattern is rotated, pattern with the flower is obtained by rotating it from 0^0 to 360^0. And an intricate pattern is obtained.

ALGORITHM

1) Initialize height and width for the frame in which the design will be displayed.

2) Initialize and apply values to radius for circle points and npoints.

```
nPoints = 10;
radius = 150;
```

3) initialize and provide values to the radius of ellipse forming flower.

```
ra = 20;
rb = 80;
```

4) check for loop also initialize interval of 10 i.e spacing between 2 single pattern is 10mm.

5) Check for angle i.e. rotating it from 0º to 360º and obtaining flower in circular fashion also use function draw ellipse in ellipse.

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4. Result

Results from above algorithms are obtained below polygon (with 8 edges), combination of concave and convex star stars and combination of flowers respectively.
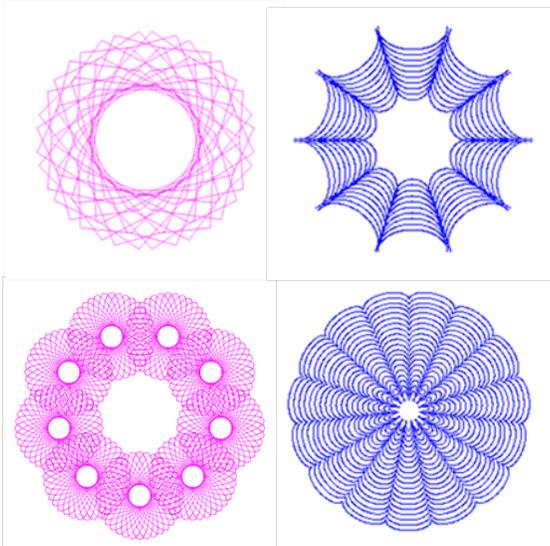
5. Conclusions

Guilloches (bands of thin intertwining lines similar to ones you can see on banknotes), which are traditionally used for security printing, are purposed as a protection against counterfeit and forgery. Guilloches also add certain aesthetic value to documents, such as lottery tickets, certificates, diplomas and letterheads, etc.

Taking use of our method, with the beyond imagination, we can generate various beautiful and complex designs. For example, badge pattern can also be achieved by the Guilloche pattern. These patterns are embossed on alphabets which can be used in number plates of car or it can be embossed on any confidential document to secure it.

6. Referances

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