Guilloche as a special kind of printed documents protection

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Abstract

For today one of the biggest problems is counterfeit false documents, securities, demand on which considerably grew in the last few years. The growing level of quality of printing equipment, operative, economic and high-quality print furthers this.

That is why development of technologies of documents protection from forgeries has already become a prerogative of scientific research organizations a long ago. The print paper, paint, design of documents and other printing products are provided with unique qualities.

Due to the 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. They are often used in package labels.

1. Introduction

Documents protection from forgeries has always been one of the major tasks in any society at all times. 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 [2].

Guilloche provides the very high degree of securities protection. Guilloche composition cannot be exactly reproduced on a digital manigraph so far as the 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.

Broadly speaking the process of preparation of the protected document with computer technologies can be presented like this. A user creates vector guilloche images in the special program by setting the building parameters known only to him. Then in the program of make-up the separate guilloches are combined into the unique composition, text information is added, color selection is performed. Then depending on the technology a graphic image is transferred to printing forms from which printing is made with the printing-press.

2. Basic types of documents protection

All printing products protection technologies that are used presently can be divided into five large groups: protection at the stage of design, protection due to special printing technologies, and protection by using special printing basis, paints, protection due to after processing of products [6].

The basic technologies of protection on the different stages of making documents are represented on Fig. 1.

3. Guilloche as a method of protection

The technology of guilloches for documents protection has been already in use for many years. However, the technology of guilloches is constantly improved.

Nowadays they are not made on the special mechanical guilloche machines, but designed on computers and printed with either offset or multicoloured Orlov print.

Guilloche is a special technology of protection of documents and securities by composition of different guilloche elements on the surface of a document which is protected.

Guilloche figures consist of plenty of identical elements. The thickness of lines is regulated and must not exceed 40-90 microns. A structure of graphic elements must be irregular and must occupy not less than 70% of document area [2].
Guilloche element is a figure with the multitude of thinnest secants set with mathematical formulas. Usually guilloche elements are protective grids of different kinds, rosettes, borders, vignettes and corners.

A protective grid is a background figure formed by continuous or broken lines that are either parallel or intersected (Fig.2). In the printing industry the imposition of a few grids of different colors is widely used for protection. On real documents in the points of intersection of grids lines knots and bulges are not allowed. Protective grids, as a rule, are executed by offset printing presses in dim pastel tones; it makes difficulties for their reproduction.

A rosette consists of two basic groups which are responsible for an internal and external form. That is first basic lines are built and on the basis of them rosettes are built. The form of basic curve determines the edge of rosette. Next the space between curves is formed by the filling made by certain functions. The type of the rosette is shown in Fig.3.

Borders are one of the types of guilloche elements (Fig. 4). There are rosettes with different filling and of arbitrary types. The technology of border creation provides for construction of horizontal or vertical line only. With the methods of copying and quarter turning it is possible to attain creation of corners (Fig. 5).

For creation of border it is necessary to use basis of the type: a segment, two envelope curves and the filling.
A vignette (Fig. 6) is a type of guilloche elements that is used for protection of securities, certificates, blanks, diplomas. It consists of thin curves that form a unique figure which is difficult to reproduce on copying machines.

4. Information technologies of guilloches creation

The market of guilloche graphics software is rather thin; moreover, most products presented are additional modules for the popular vector graphics editors, primarily Adobe Photoshop, Adobe Illustrator and CorelDRAW.

They are characterized by a relatively low price and the same limited functionality, and the end products can be used only as decorative elements, they are not difficult enough to provide protection of documents.

Also high-quality and difficult for the construction are the technologies of guilloche elements that are widely used for protection of different types of documents created by the SecuritySoft Co, which offers a graphic package in the arsenal of which there are three lines of products: Cerber, SecureDraw, Glissando [7].

PostScript is a good alternative to the existent programmes of development and editing of vector elements and allows effective protection of the printing products without great efforts.

PostScript is the page description language (PDL), designed to create and print images of arbitrary complicity. For this reason the language has a wide set of graphic operators which can be used in arbitrary combination [4].

5. General method of guilloches creation

Guilloche elements are created stage-by-stage. At first the basis on which subsequent steps will be built is set. The «basis» is a basic line that determines the form of the future guilloche element. Bases can be of the followings types: a line, an ellipse, a polygon, a rectangle, a polyline, an ellipse’s arc, an oval, a spline, a spiral, an evolvent, a lissage.

On the second stage two envelope curves that serve as a basis for all other lines are set.

The «envelope curve» is a line built on the «basis» with the use of functions determined by a user that serves for shaping future guilloches. The «basis» acts as the original system of coordinates, on the basis of which a function is built.

The basic parameters of the «envelope curve» are the amplitude (sets the amplitude of function), the phase (sets the phase shifting of function), the shifting (sets the relative distance from the function to the «basis»), the frequency (sets the amount of the function repetitions), the basis (the «basis» on the basis of which the «envelope curve» will be built), the function (sets the function which will be used to build the envelope curve), the inclination (sets the direction of the function shifting in relation to the «basis» and sets the variable law of inclination).

And only after that the functions on filling the space between the given curves are set. The «filling» is a multitude of lines, built on the basis of two «envelope curves» with the use of chosen functions. Lines fill the space between two envelope curves.

There are such types of fillers as: linear, phase, special, text, decorative pattern, combined, radial.

Functions are the objects set by a user and used for the description of curves and surfaces. Functions are used for setting envelope curves, fillings, surfaces, etc. Functions can be set with the help of: the Fourier row, the formula, the raster file [3].

The commonly accepted single element which is used to create guilloches is Bezier curves. To create a baseline grid one graphic element is not enough. Therefore to build a graphic element a few segments of Bezier curve combined are used. At combination building dots of a graphic element are divided into basic ones, those that a graphic element contains, and tangents ones which serve for segments coupling. Thus, a graphic element is got by combination of a few segments. Therefore there is no single analytical expression for building a graphic element. It needs to be calculated by parts. This method has no clear binding to the system of coordinates, it is impossible to define if the given dot belongs to the graphic element or not. The Bezier curve built on three dots does not necessarily contain the given dots. The indicated disadvantages of the existent methods of protective grids building diminish their efficiency considerably [5].

Creation of guilloche elements on the base of cyclic functions enables to improve the quality of an image and controls every dot of a document. An epitrochoid, an epicycloid and an hypocycloid is belong to them (Fig.7).
6. General algorithm of guilloches building with the facilities of PostScript language

The method of guilloches creation is based on the analysis of structure of PostScript-file (ps-file) and it uses the PostScript programming language that for today is a certain standard in publishing [4]. The guilloche building provides for creating of a document in the certain imposition programme. A pattern formed in any imposition programme can be an initial file.

The next stage is building of a single graphic element, whereupon a design is made and a form of a guilloche element is developed. When building thin graphics it is possible to regulate color, thickness and type of lines. To create guilloches a graphic element is multiplied by parallel transfer, turn, pressing or extension, and it is copied by different combinations. In accordance with a certain design a postscript language programme code is formed; it implements the chosen design of protective grid, whereupon a file in the ps format is created. In the case of necessity a file can be changed to Pdf format, which allows saving the exact formatting of documents and is in a position to compress them effectively [1].

7. Conclusions

This work is devoted to the research of the methods of documents protection and creation of guilloches for printing products protection. This branch of printing is very important as reliable information is valued most of all in the world. The prestige of a firm depends on quality of its products and that is why the research of the effective methods of protection is the topic of interest.

It was investigated that guilloches are formed by graphic primitives, such as a line, a polyline, an arc, an oval, a rectangle etc. as well as other more difficult compositions: a border, a vignette, corners and baseline grids.

Also the algorithm of guilloche elements creation based on cyclic functions that enables to improve quality of an image and performed control in every dot of a document is developed.

Bibliography


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