



CREATING A GRAPHICAL USER INTERFACE FOR THE DESIGN OF NATURAL FORMS WITH COLOR DECOMPOSITION

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Abstract: *Graphical user interfaces for the design of shapes, combined with a different number of colors, facilitate the work of the designer, but on the other hand generate a limited number of figures. In the present paper a software tool for realization of methods and procedures for generating geometric elements has been developed. Pantone® colors have been used for a decade (2010-2020). The created graphical user interface offers opportunities to add new shapes, colors and controls. It is implemented through open source software tools. This significantly expands its possibilities for use by users who can add, change, customize, improve software tools. This minimizes the technical realization of the graphic elements and allows the designer to focus his efforts on the creative part in creating the final product. The technical tools proposed in the present work can be used in the creation of elements for friezes and patterns for textile design. Also, the results of this work can be used in the training of future specialists in the subject area.*

Keywords: *Data analysis, GUI, Textile design, Pattern making, Open source*

1. INTRODUCTION

The shapes and forms are the basis for creating elements in the design of fabrics. They represent logos, illustrations, friezes, patterns and they help the designer to give style to the fabric and to organize the elements in different patterns.

Colors play a significant role in design, followed by shape, symbols, descriptions. They not only influence emotions, but they also hold meaning. The perception of color is based on the cultural understandings of consumers. The choice of colors and their combination with shapes is extremely important for the overall success of fabric design and how it will be perceived by consumers. The shape and color of the elements that make up the decoration of the fabric are interrelated [1];

In the art of fabric design, in addition to purely artistic features, there is a number of technical requirements that confront the artist with certain limits, such as the size of the repetition, the limited number of colors [2].

Therefore, the peculiarity in the composition of decorative fabrics is in the organic relationship between the properties of the material, the purpose of the product, its decoration and shape. The composition of decorative fabrics can be with a clear center, with figures arranged in a circle, square, with borders, with ornaments along the entire width and length. The types of decorative compositions that are used in the creation of designs for patterns are: frieze, closed, open compositions. In all cases the composition must bring together all the decorative elements [3].

In recent years, there has been an increased interest in the use of computer-generated forms in the design of fabrics, clothing, logos [4].

Creating shapes and combining them with colors, using computer-based tools, requires knowledge of programming, working with CAD systems and design [5].

Designers cannot be expected to be programmers and mathematicians to create their own shapes, to combine them with different colors, using the capabilities of computer technology.

Software tools are designed that facilitate the process of creating computer-generated shapes and combining them with different colors. A significant part of the publications in this field is represented by mathematical descriptions of various geometric shapes from nature [6]. Graphical user interfaces (GUIs) are available for shape design [7], combined with a different number of colors. These software tools facilitate the designer's work in designing their elements, but on the other hand offer the generation of a limited number of figures.

In this form, technical and mathematical tools, to some extent, limit the ability of designers to create shapes for patterns of fabrics, using the capabilities of computer technology.

In the Matlab software system (The Math Works Inc.) as well as its free analogue Octave (GNU Octave), there are several ways to compile a user interface: Text, GUIde, Figure.

Regardless of how the graphical interface is created, this activity involves two main stages [8]:

- ✓ Use the controls and coordinate axes on the graphics window;
- ✓ Programming events that occur when a user influences an object, such as pressing a button.

The main elements in computer-generated figure creation systems are graphical user interfaces [9]. While creating them, it is necessary to follow a number of steps to make them easy to use, effective, intuitive [10].

The purpose of this article is to propose an algorithm for creating combinations of computer-generated shapes and colors to be implemented through a graphical user interface.

2. MATERIAL AND METHODS

The colors used are presented. The way of color decomposition is demonstrated. The used figures and the software used for their creation are indicated.

Table 1 shows the RGB and Lab values of the colors of the Pantone® for one decade (2010-2020). This decade is even, which means that the colors are lighter than the previous one (2000-2010) [11, 12]. During this decade, Pantone® chosed two colors of the year in 2016. This is related to a current trend in 2016 for gender equality [13].

Table 1. Colors of Pantone® for a decade (2010-2020)

Year	Pantone color	R	G	B	L	a	b
2010	PANTONE 15-5519 Turquoise	66	181	166	67,25	-35,69	-1,89
2011	PANTONE 18-2120 Honeysuckle	214	79	119	53,19	56,21	6,05
2012	PANTONE 17-1463 Tangerine Tango	221	65	36	51,01	58,09	50,75
2013	PANTONE 17-5641 Emerald	3	155	117	56,83	-43,89	10,35
2014	PANTONE 18-3224 Radiant Orchid	180	99	159	77,91	-13,62	17,90
2015	PANTONE 18-1438 Marsala	152	80	81	42,77	30,04	12,99
2016	PANTONE 13-1520 Rose Quartz	247	202	202	85,14	15,89	6,00
2016	PANTONE 15-3919 Serenity	147	169	209	68,88	1,59	-22,82
2017	PANTONE 15-0343 GREENERY	108	165	58	62,00	-36,83	48,03
2018	PANTONE 18-3838 ULTRA VIOLET	100	84	149	39,95	21,96	-33,49
2019	PANTONE 16-1546 Living Coral	255	112	98	64,75	53,52	34,86
2020	PANTONE 19-4052 Classic Blue	15	76	129	31,48	2,36	-35,04

The decomposition of the color is done in three colors. This approach has the advantage over using only two colors because it adds depth to the generated figure. Figure 1 shows a pseudocode for determining the transition between two colors. These calculations are made between the individual RGB components of the two colors. The decomposition between the first and second color has to be calculated, and then between the second and third.

```
%Input variables
Start_color;
Stop_color;
Num_elements;
Index;
%Output
out = Start_color + (Index-1) * (Stop_color - Start_color) ./ (Num_elements-1)
```

Fig. 1. Pseudocode for calculating the transition between colors

The method of creation of used figures is presented in detail in [14]. The next figures are used:

- ✓ Maurer's Rose;
- ✓ Rose;
- ✓ Spiral.

The figures are complemented by a circle element, which have an increasing radius and are colored with the decomposed colors.

Figure UI tools in the Matlab software environment (The Math Works Inc.) were used to create a graphical user interface.

A fully completed and working software application with a graphical interface has been developed. They are created and connected with the control graphic elements, their respective callback functions.

3. RESULTS AND DISCUSSION

The developed graphical user interface is presented and it is shown the sequence for working with it. The possibilities for its realization in an open source software environment are described. A textile design with GUI-generated elements is proposed. A comparative analysis is made with other publications in the subject area.

Figure 2 shows a general view of the developed graphical user interface. It is a form implemented through Figure UI.

The graphical user interface of a software system for obtaining figures contains a total of 12 controls.

The colors of Pantone® for the period 2010-2020 are visualized in the right part of the form. The year and RGB values for each color are presented. The purpose of this visualization is to make it easier for the user to choose colors.

Through the "Popup menu" control, three colors are selected, marked with the year to which they refer.

The same control selects the type of figure to be drawn. Below the drop-down menu for selecting the figure are sliders, through which the parameters of the figures are adjusted. The selected values of these settings are displayed to the right of the sliders. This is realized through control type "Edit. For example, the Maurer Rose setting parameters are the variables n and d . In the case of "Spiral" the settings are for radius " r " and an angle " θ " [14].

Finally, in the left part of this form, the selected figure is drawn with the transitions of the colors specified by the user.

Saving the resulting decorative figure as a file can be done through the "Edit" menu of the "Figure" element (Edit-Copy Figure). It is stored in the Windows Clipboard and can be placed, for example, in an image processing program or other suitable program that the user uses.

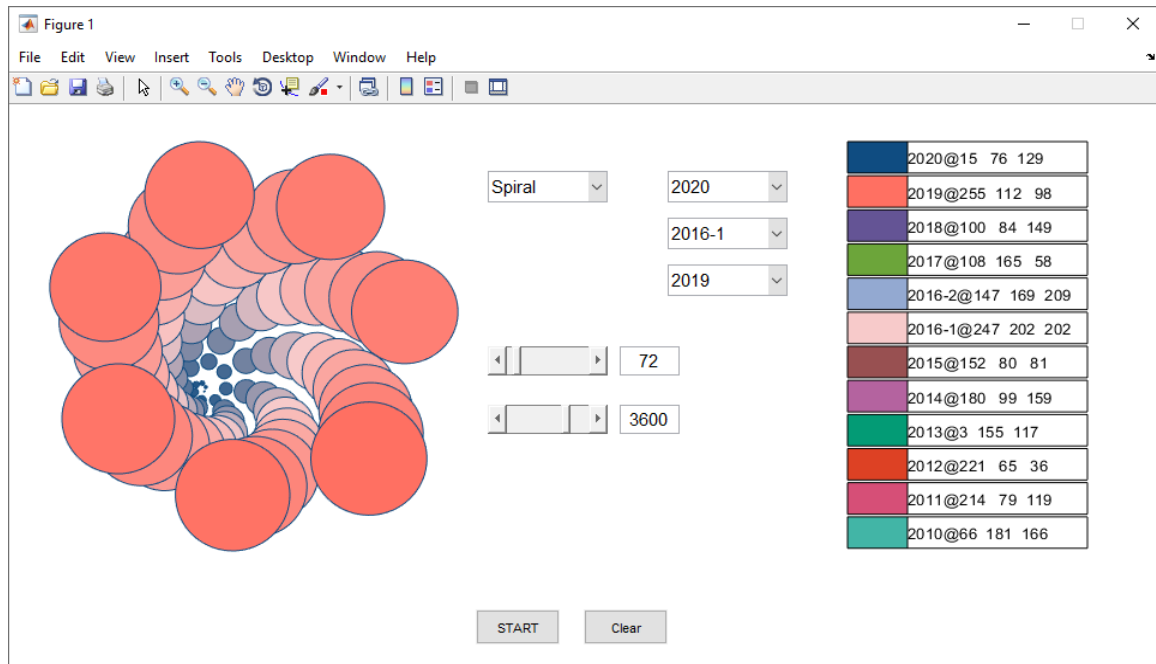


Fig. 2. Graphical user interface - general view

Figure 3 shows a block diagram of the sequence of operation with the graphical user interface (GPI). After starting the application, adjust the figure. The type of the figure, its colors and the parameters for its construction are selected. Then the figure is generated and it can be saved as a file.

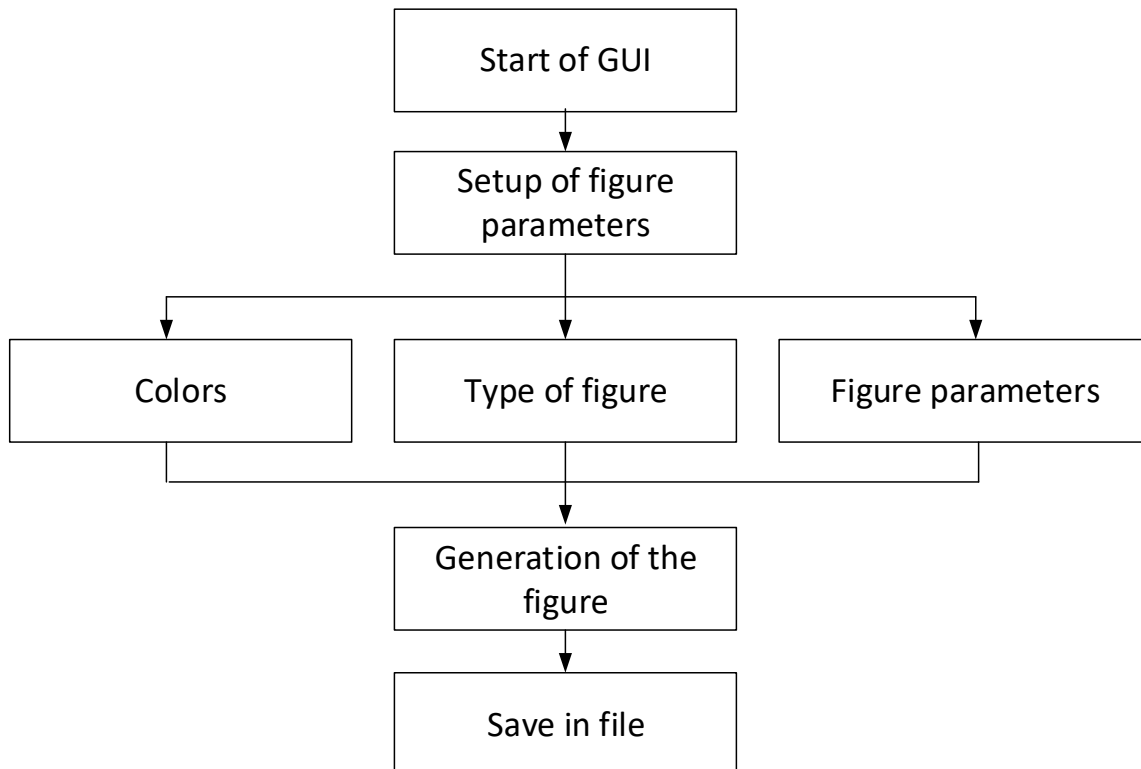


Fig. 3. Sequence of work with GUI

The presented figures can be realized in GNU Octave (<https://octave-online.net/>), which is a free analogue of Matlab. After registration, the user can use the full functionality of the online programming system. Also Octave can be downloaded completely free as a desktop application.

Figure 4 shows a screen from the online software system Octave, through which the figure "Spiral" is realized, through colors and circles used in the graphical user interface. The figure can be exported in the *.PNG and *.SVG file formats.

The proposed graphical user interface is developed in the Matlab programming environment. After a partial modification, it can also be implemented in GNU Octave.

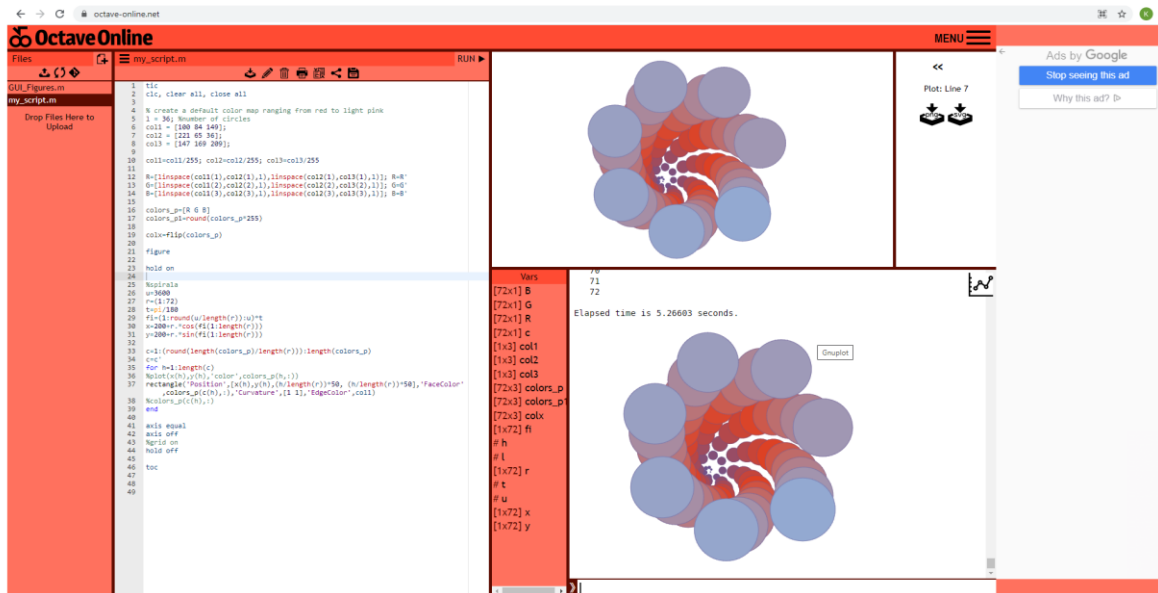


Fig. 4. Realization of a figure in Octave

Figure 5 shows some decorative elements generated by the developed GUI. In addition to the basic settings, the drawing of the figures can be modified in the computer program so as to use elements other than a circle, for example an ellipse, a square, a rhombus, an asteroid.

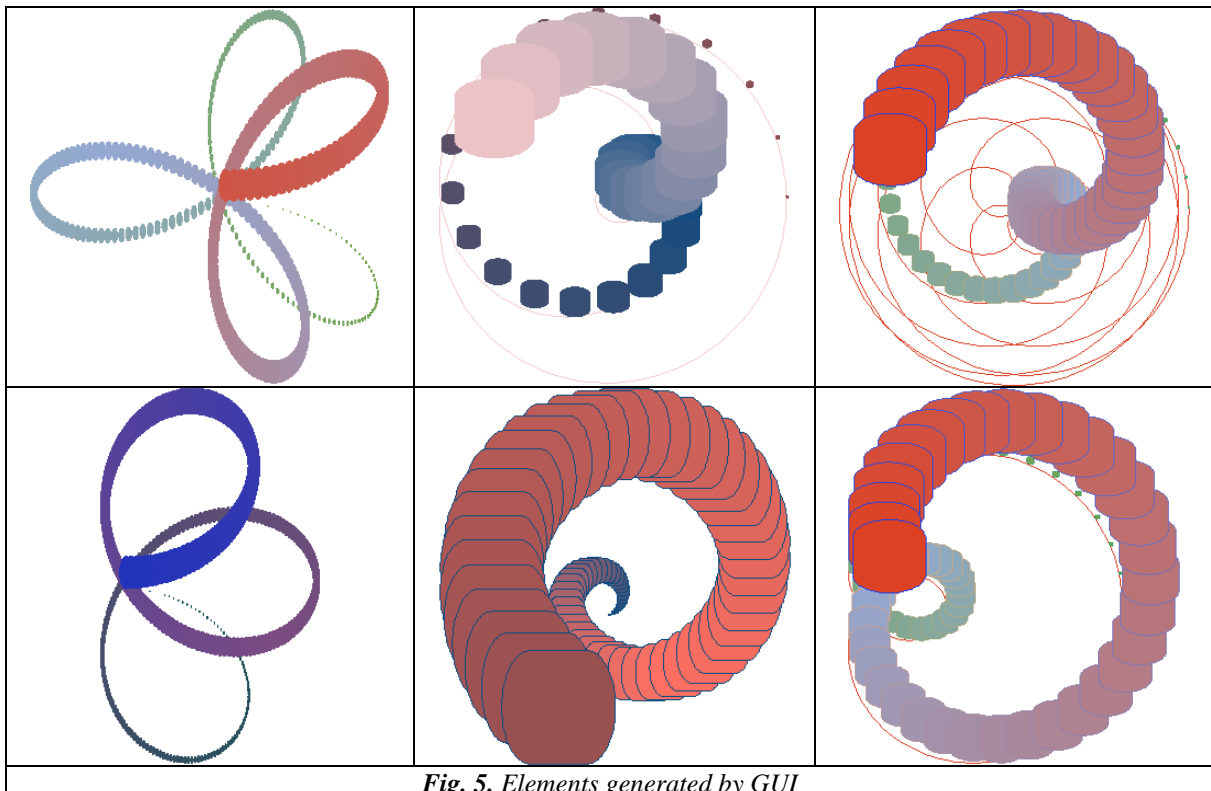


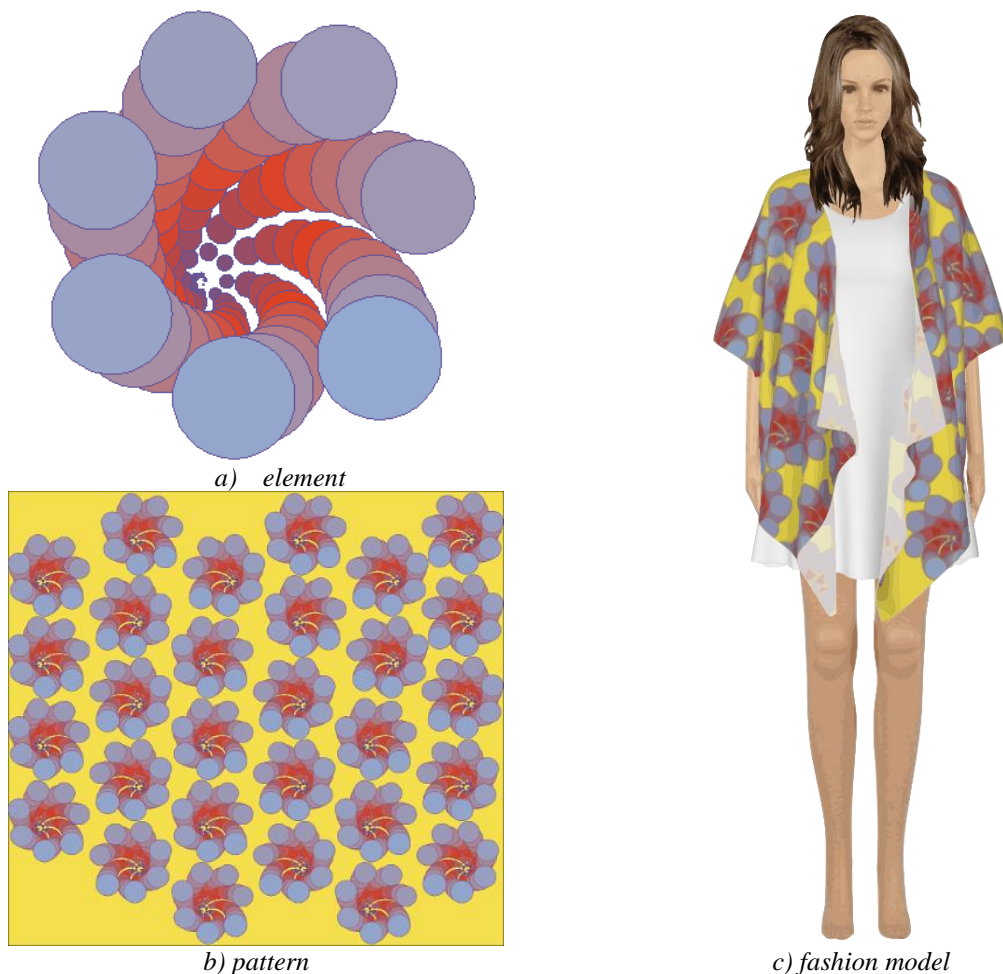
Fig. 5. Elements generated by GUI

The generated elements can be used to create patterns to be used for the design of fabrics and clothing, respectively.

Figure 6 shows an example of the use of a pattern in clothing design.

An online tool Design Lab (<https://artofwhere.com>) was used to visualize the model. The model was created in the Inkscape software environment (<https://inkscape.org>). It consists of a mannequin, a wig and clothing.

The element is a spiral, generated by the procedure described above. The pattern is created by Half-drop repeat with a mirror arrangement of the elements. The clothing model is a draped kimono. It is an everyday outfit that can be worn by the ladies around the pool, on the beach, at home. The kimono can be easily combined with summer dresses, tank top, pants, skirts, shorts.



a) element
b) pattern
c) fashion model
Fig. 6. Example of a fashion model, from elements created by GUI

The results obtained in the present work confirm and on the other hand supplement those of the available literature.

The GUI proposed here expands the possibilities of that proposed by Li et al.[7] by adding the ability to select more than one figure, keeping the choice of transitions between three colors.

Another advantage is the use of open source (APPENDIX A). In this way, the user can supplement the main program with colors, new shapes and controls, depending on their needs.

By adding program code to the GUI, the user can use known figures whose mathematical dependencies have been published [15]. This also solves the problem of the need for programming knowledge to use figures that are represented by their mathematical equations [6].

4. CONCLUSION

A software tool has been developed for the implementation of the proposed methods and procedures for generating geometric figures.

The created graphical user interface complements those developed so far, with the ability to add new figures, colors and controls. It is also possible to implement add-ons through open source software tools. This significantly expands its possibilities for use by users who can add, change, customize, improve the software tools implemented in the GUI.

The advantage of the software tools proposed in the present work is that when creating shapes and combining them with colors, through the use of computer-based tools, no knowledge of programming is required. This minimizes the technical realization of the graphic elements and allows the designer to focus his efforts on the creative part in creating the final product.

The technical tools, proposed in the present work can be used in the creation of elements for friezes and patterns for textile design. Also, the results of this work can be used in the training of future specialists in the subject area.

ACKNOWLEDGEMENTS

This work is partially supported by project №02.OUP/2020 “Construction of infrastructure for processing and analysis of data from contactless sensors with the application of machine training”.

APPENDIX A. Free access to the developed GUI

The developed software tools are freely available as a ZIP archive on the following Internet link: <https://drive.google.com/file/d/1Iwe17BsuVeSkof0tAfjb3TOOp6sO70-i/view?usp=sharing>

When using the software tools, this article needs to be cited.

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