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Software for Creation of a Database of Ornamentation of National Woven Fabrics

Abstract
We present an original software package for the creation of a database which would enable the storage of ornamentations of national fabrics. A suitable design of the database is the keystone for selecting software which would allow the storage, re-design and visualisation of ornamentations effectively, accurately, and efficiently. The software we have developed contains three main modules which have the following functions: the creation and loading of a database, the presentation of a record set in the 'ornament design window', and printing the record set data with the aid of a specialised window. The second module is the main one, because provisions are made for the researcher (for example, an ethnologist or museum-specialist) to understand more deeply a given ornament's structure and the methods of its creation. The ornament notation system we propose allows the presentation of an ornament as analysed in the 'ornament design window' in a view that corresponds completely to the original sample. In addition, this database allows the textile designer to choose a segment stored therein, to create a new ornament using the symmetry operations, and finally to compare it with the original sample. The database application program presented contains Lithuanian national ornaments, but it can be successfully used in a broader context for the analysis and comparison of the ornamentation of various cultures.

Key words: *woven ornament, segment, symmetry operations, symmetry group, software, database.*

Introduction

Research into various areas of folk art is important and significant for every nation, and it is an essential part of a community's national consciousness, as well as aiding the better understanding of the development of the world's cultures. It is extremely important to investigate, analyse and record those cultural values which would permit the nature of the nation to be uncovered for the community of the world, and to present the originality of the character, traditions, and customs, as well as regional distinctions.

Various national Lithuanian textiles can contribute to the interpretation of such cultural links between nations. Such articles as coverlets, bedspreads, tablecloths, sheets, towels, blankets, sashes, etc., can sometimes be found in people's homes even today, but the large collections stored in art museums are of fundamental importance. However, unfortunately most of them are not exhibited, because of the small area of the museum rooms. They are kept in the museum's funds storage areas, and are often only described in books of derivation metrics, so they are hardly accessible to wider research circles. Another reason for their poor accessibility is the high sensitivity of these often antique items to external influences. These circumstances prevent the analysis, systematisation and creative development of these riches of the national cultural inheritance which have in the meantime still survived. They must be preserved for future generations, and must also serve to introduce designers or other visitors to museums to these collections, especially the youth, who must thus attain a sense of the national culture's beauty and aesthetic feeling.

While analysing the textile ornamentation, it was noted that the ornaments conform to symmetry concepts which have their origins in the scientific investigation of crystals. H. J. Woods, an English physicist, proposed a general system of notation and classification of ornaments [1], which was later improved by M. A. Hann et al. [2,3]. This system covers ornaments which can be realised by all possible technologies. It is expected that woven ornaments also conform to the general symmetry concepts, and that the general Woods & Hann system of notation and classification is applicable for this kind of ornament. On the other hand, woven designs have some specific limitations caused by the technology and the structure of woven fabrics. Moreover, there is no other area of folk art which has been influenced as much by technology in its stylisation form of symbols as woven textiles. These problems were analysed previously and solved mathematically by V. Milašius et al. [4,6,7].

So, the main aim of this article is the description of the development of a notation system for woven ornaments, the creation of an up-to-date computer based system for analysis and synthesis of wo-

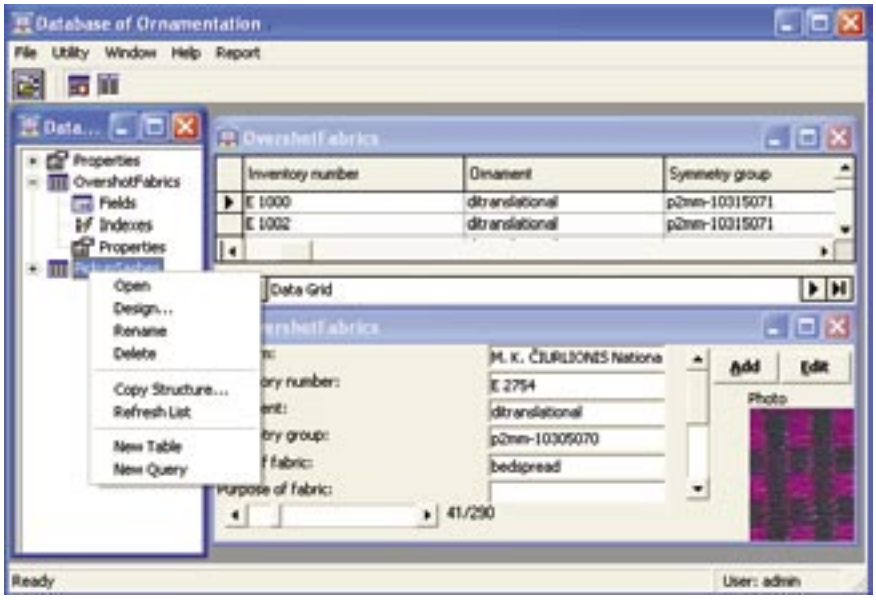

Figure 1. *Window of creating and loading databases.*

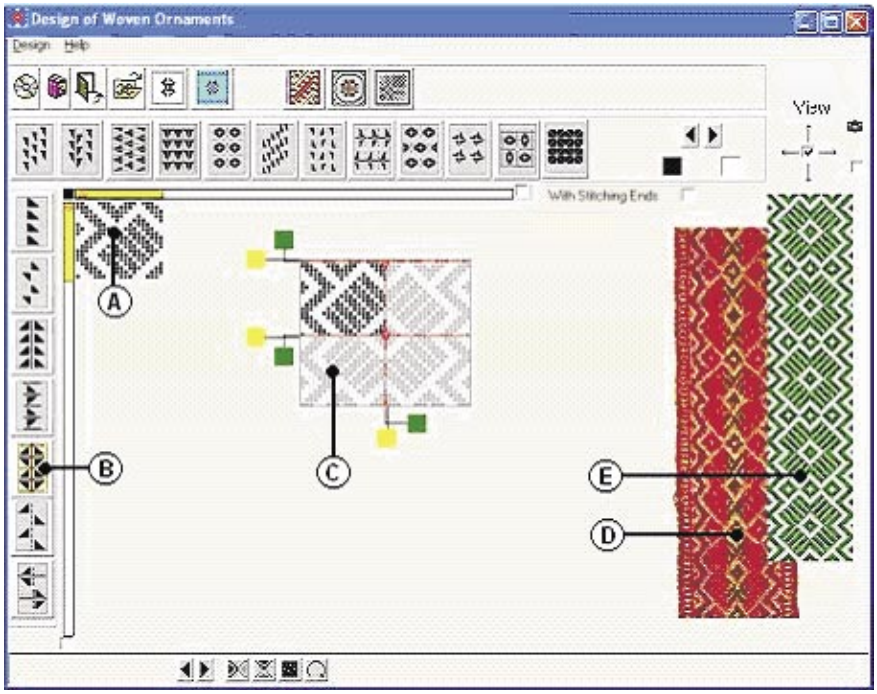

Figure 2. *Window of record presentation in the 'ornament design window'.*

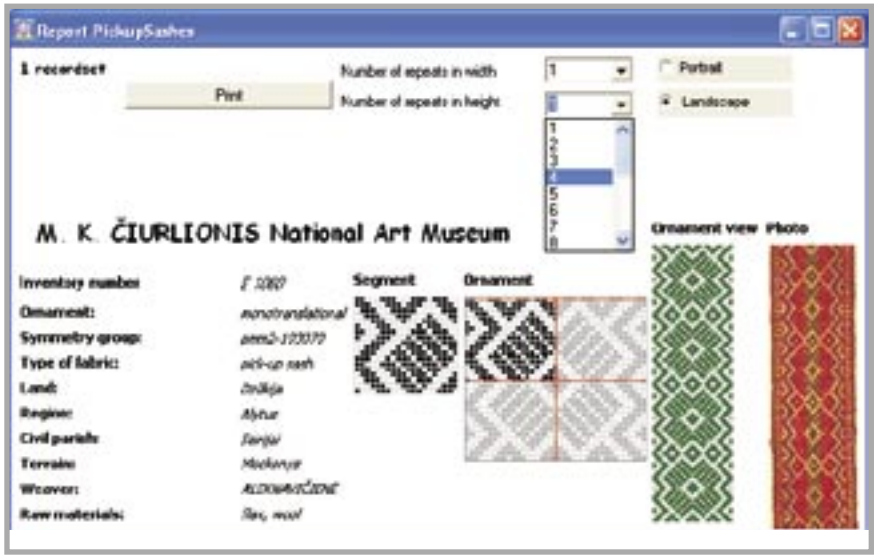

Figure 3. *Specialised window for record data print.*

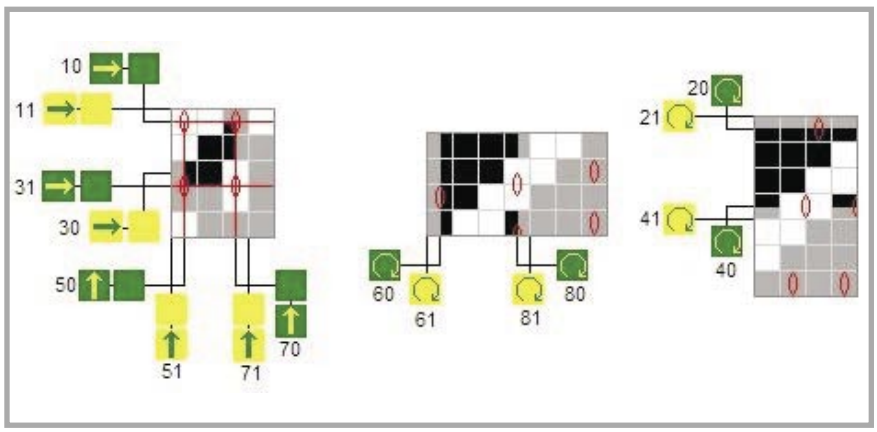

Figure 4. *Operations of woven segment transformation and their symbols.*

ven ornaments, as well as its preservation for further progress of the national textile ornamentation which forms part of the national cultural inheritance.

Database of National Lithuanian Woven Fabrics

An original software package for the creation of a database for ornamentation of Lithuanian national woven fabrics is presented. This software contains three main modules:

1. the creation of the databases: loading and description (Figure 1),
2. presentation of the record sets in the 'ornament design window', analysing and re-designing (Figure 2),
3. a specialised window for printing record set data (Figure 3).

The first module serves not only for storage but also allows us to take a look of the database properties, the structure, the parameters, and the record sets stored, with the aim of designing new databases to create, to delete, to copy, to rename the database sheets, to create queries, to refresh, to edit, to save, to sort the records, and so on, i.e. it executes the common procedures for each database operation. After the programme is loaded, the parent and daughter windows of the database directory appear. When the desirable database is selected, the record set can be presented in the daughter windows as either a 2D-form or as a table. In the 2D form, the record set is presented in separate successive daughter windows. The complete information of the showpieces which the museum has at its disposition can be presented in this window.

The next module, the presentation of records in the 'ornament design window' is the main module, because provisions have been made for the researcher (e.g. an ethnologist or museum-specialist) to understand more deeply the ornament's structure and the methods of its creation. The new system of the woven ornament notation which we have developed has to be created for ornament presentation in the 'ornament design window' in a view that would completely correspond to the original sample. Furthermore, the software of the database should enable the textile designer to select the segment stored in the database and to create a new ornament using any symmetry operation, and finally to compare it with the original sample. The third module serves to print all the of one record.

Developing Ornament Notation for Woven Fabrics

Any ornament of the woven fabrics can be created accordingly to the following operations [1,2,3]:

- translation - the basic ornamentation segment is repeated at regular intervals in any single direction, and at the same time the orientation of the segment is retained;
- rotation - the basic ornamentation segment is repeated at regular angular intervals around an imaginary fixed point called the centre of rotation;
- reflection - it is the mirror image of the basic ornamental segment across an imaginary line called the reflection axis.

The glide-reflection is a combination of translation and reflection operations.

The international classification and notation system of ornamentations divides all regularly repeating weaving ornaments into two classes: mono-translational and di-translational ornaments. These two classes are subdivided into seven and seventeen groups respectively. More explanation about the classification of ornaments is given in [1-3]. The first distinction of woven ornaments from other kinds arises because the ornamental motifs of some groups with a three-fold (*p311*, *p3m1*, *p31m*) or a six-fold (*p611*, *p6mm*) rotation cannot be used because they cannot be delineated by a rectangular system, as is necessary for the structure of the fabric's weave repeat. For this reason, only twelve of all the seventeen di-translational symmetry groups can be used for the description of woven ornaments. The second distinction of woven ornaments derives from the circumstance that the position of axes or centres of symmetry operations in the basic segment of a woven ornament can only be placed either between the columns (rows) or on the columns (rows), i.e. the threads. The third distinction comes from the second, and deals with di-translational symmetry operations: some of them (*p111, p1g1, c1m1, p1m*1, *p211, p2gg, p2mg, c2mm*) carried out by transformation of the segment in two perpendicular directions (say, horizontally and vertically) make two different ornaments. So, eight new symmetry group operations come into being. More explanations of the features of woven ornaments are given in [4-7]. All these distinctions cause the need for creation of a new notation system for woven ornaments.

The new complete notation system for woven ornaments contains international notation symbols and is supplemented by one, two, three or four groups of numbers. Each group of numbers contains two digits and specifies a particular operation of the segment transformation (Figure 4): the first digit specifies the symmetry operation (Table 1), the second digit can be only either 0 (if the symmetry operation axis is on the thread) or 1 (if the symmetry operation axis is between

Table 1. *Description of the segment transformation.*

Segment transformation symbol	Description of the segment transformation
1	Reflection or glide-reflection in point of outside horizontal axis
2	Rotation around the point on the outside horizontal axis
3	Reflection or glide-reflection in point of middle horizontal axis
4	Rotation around the point on the middle horizontal axis
5	Reflection or glide-reflection in point of outside vertical axis
6	Rotation around the point on the outside vertical axis
7	Reflection or glide-reflection in point of middle vertical axis
8	Rotation around the point lying on the middle vertical axis

Table 2. *Complete codes of mono-translational ornaments symmetry groups.*

International symbols	Segment transformation (1-8) and axis location (0-1) symbols													
	1		2		3		4		5		6		7		8	
p111																
p112			20	21			40	41								
p1a1													70	71		
p1m1													70	71		
pm11	10	11			30	31										
pma2			20	21	30	31										
pmm2	10	11			30	31							70	71		

Table 3. *Complete codes of the di-translational ornaments symmetry groups p2mm, p411, p4gm, p4mm.*

International symbols	Segment transformation (1-8) and axis location (0-1) symbols															
	1		2		3		4		5		6		7		8	
p2mm	10	11			30	31			50	51			70	71		
p411			20	21			40	41								
p4gm			20	21	30	31										
p4mm	10	11			30	31										

Table 4. *Complete codes of the di-translational ornaments symmetry groups p111, p1g1, c1m1, p1m1, p211, p2gg, p2mg, c2mm.*

International symbols	Segment transformation (1-8) and axis location (0-1) symbols																Orientation	Shift
	1		2		3		4		5		6		7		8			
p111																	v	zn
																	h	zn
p1g1	10	11			30	31											v	zn
									50	51			70	71			h	zn
c1m1					30	31											v	
													70	71			h	
p1m1	10	11			30	31											v	
									50	51			70	71			h	
p211			20	21			40	41									v	zn
											60	61			80	81	h	zn
p2gg			20	21			40	41					70	71			v	
					30	31					60	61			80	81	h	
p2mg			20	21	30	31			50	51							v	
	10	11									60	61	70	71			h	
c2mm	10	11			30	31							70	71			v	
					30	31			50	51			70	71			h	

the threads). All possible notations of the mono-translational symmetry groups are presented in Table 2. Below are listed examples of notations of the description code for mono-translational ornaments *pmm2-103070, pmm2-103171, pmm2-11307*, etc. Some di-translational symmetry groups have the same structure of notation (Table 3).

Some of the di-translational ornaments (created by *p111, p1g1, c1m1, p1m*1, *p211, p2gg, p2mg, c2mm* di-translational symmetry groups) can be designed by transforming the segment either horizontally or vertically. Therefore these ornaments must be specified by symbols describing the direction of the orientation, either *v* (vertically) or *h* (horizontally). These symbols are subjoined after the complementary group of numbers which have been presented above (Table 4). In the case of glide-reflection, the codes for *p1a1*, *p1g1* symmetry groups are completed by the symbol *z*, and a number which corresponds to the shift of the glide-reflection operation. For di-translational ornaments of parallelogram-form cells created by *p111* and *p211* symmetry groups, the code is likewise completed by the symbol *z*, and a number which corresponds with the shift of the displacement or with the angle of the parallelogram [1-3]. In both cases this number must be any positive integer number from the interval [1-(*a*-1)], where *a* corresponds to the number of columns in the case of horizontal orientation of the segment transformation, and the number of rows in the case of the vertical orientation of the segment transformation. Examples of a di-translational ornaments code are *c2mm-103070v* and *c2mm-315071h*.

Notation System and Database for Woven Fabrics

The above-described new system of woven ornament notation is connected with the database created and the presentation of record sets in the 'ornament design windows', and also provides the investigator to analyse the database records. Two design modes of the software are provided:

1. ***The self-acting hidden design mode***. In this case, when the menu button ***Report*** (Figure 1) is activated, the ornament's design mode is activated, all necessary actions are performed, and in the specialised window for 'record data print' (Figure 3) the complete description of the analysed record appears. It precisely presents the relation of the showpiece from the database to a particular symmetry group, and the principles of segment transformation. In the report, the text of the metrics, the segment, the repeat of the ornament, the photo, and the computer simulation of the ornament views are presented using appropriate symmetry groups, appropriate symmetry axis location and so on. In the case of the international code (without the complementary parts of the woven ornament's notation), the segment and photo of the ornament will be presented alone.
2. ***The open design mode***. In this case, when the menu button ***Design*** (Figure 1) is activated, the design window opens (Figure 3) with all the necessary information about the method used for the ornament design: **A** - segment, **B** - symmetry group, **C** - the ornament's repeat based on all the rules of its transformation presented by the complete code, **D** - the showpiece photo from the database, and **E** - a computer simulation of the ornament view.

A real database based on the program application presented above has been created. It contains a part of the textile collection of the M. K. Čiurlionis National Art Museum in Kaunas. The database has been installed in the computers of the Museum for practical use. Although the database application program and the real database created contains only Lithuanian national woven ornaments, it can be successfully used in a broader context for the analysis and comparison of the ornamentation features of various nations.

Conclusions

A new improved version of the international ornament classification and notation system for woven ornaments is proposed. In this system, the international notation code is supplemented by one, two, three or four groups of numbers (each of them containing two digits: the first for description of the symmetry axes, and the second for its location), by a symbol describing the direction of the segment's transformation orientation, and by a symbol and number which correspond either to the shift of the glide-reflection operation, or to the angle of the parallelogram for the symmetry groups including the parallelogram-form cell.

The software proposed offers all the features of the database, its structure, parameters, and record sets, allowing the design of new databases, to create, delete, copy, rename and delete the database sheets, to create queries, refresh, edit, save, sort the record sets, to find the records' data by certain attributes showing the quantity of the chosen records, to show the graphic materials, photos of the showpieces, segments, ornament's repeat, computer simulation of the ornament's view, etc.

Using the new notation system, the software created allows the presentation of the ornaments analysed (in the 'ornament design window'), as well a view that completely corresponds to the original sample.

The database presented in this paper has been installed in the computers of the M. K. Čiurlionis National Art Museum for practical use. So provisions have been made for the researcher (ethnologist or museum-specialist) to understand more deeply the ornament structure and the methods of its creation. Furthermore, the software of the proposed database allows the textile designer to create a new ornament on the basis of the segments stored, using any of the symmetry operations, to compare it with the original sample, and to decide if the task we have set has been achieved.

Acknowledgements

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