A Software Module for Multi-Column Editions Design

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Abstract. The problems in the area of automation of computer publishing processes have been studied. Methods of standardization technique for forming the optimal process of prepress preparation of a multi-column printed edition have been described. The basic stages of prepress preparation, which can be optimized by means of automation, have been identified. An algorithm for a software module has been developed that will allow the automated layout of printed editions to be performed quickly and technically correctly. The designed software module is focused on multi-column editions with a small content of illustrations (up to 5%), a large and medium volume and a text of the first and second complexity level. The software module automatically selects the optimum parameters of the text content, the edition page and the edition as a whole. This automatic selection of parameters is based exclusively on DSTU, the layout standards and rules, which are embedded in the basis of the construction algorithm. The basic principles of the operation of the software module in general, as well as individual submodules have been described in detail. It is specified according to what standards and rules the automatic layout will be carried out. The presented algorithm of the conventional technology of the editorial and technical process for the prepress preparation of a multi-column edition shows what steps will be performed automatically when using the software module. The use of the software module will significantly reduce time costs, lower the complexity and optimize the process of prepress preparation of multi-column editions.

Keywords: Design, Layout, Multi-column Edition, Software Module.

1 Introduction

Nowadays, the introduction of the latest technologies, materials and equipment is constantly expanding and improving in Ukraine. The development of printing technology is characterized by the continuation and acceleration of the introduction process of digital methods and text processing tools in publishing and printing processes [1, 2, 3].

To increase the dynamics of the production process of printing products at the stage of prepress preparation of editions, computer publishing systems (CPS) are designed, which allow: to reduce the time to prepare the edition for publication significantly [4], to control the materials at all stages of their processing [5], to expand the range of editions without increasing the number of employees [6], to store and protect the information, to allow the remote work with the system, to support software of multiple heterogeneous editions and choose Mac and PC platforms.

At the present stage of prepress preparation, many different kinds of software are used for the organization of the automated production system in editorial offices and publishing houses [7]. The area of the automation of layout processes is intensively developing. Such automation is performed by software and technological means [1, 2]. Modern software tools for the layout process [5] automation are divided into three levels. Depending on the project complexity and the quality of the text information it consists of, the following tools are used for automatic processing: script libraries (macros); database export software and converters and software complexes for automatic layout.

The effective use of macros (a sequence of commands written in the internal language of the software) requires the additional documentation and professional programming skills, but in most cases standard sequences of macros can be written using standard software interfaces. Script libraries are written by professional programmers, so their main features are completeness and multi-functionality, but after the macros are applied, the project requires considerable manual improvement.

Database export software allows one to use specific templates to create formatted text that, when exported to a layout program, stores formatting attributes and is written in the internal database languages for a specific project by professional programmers. Preferably, the input information is stored directly in the database when there are text files exported from the source database in a specific format, a converter can be written that analyses the file structure and adds formatting symbols using a template or a set of rules [4].

2 Investigation of the automatic layout software complexes

An automatic layout software complex or package layout software is an intricate multifunctional complex, which requires considerable cost for implementation, but provides maximum automation of the layout process [1, 2]. The layout engineer can modify templates that store styles and modular page grids, combine templates and modify links between templates, as well as the project structure. The result of such a software is the strips laid out in accordance with the strip template, which can be transmitted to the output device after the structural verification.

One of the technological methods to increase the layout process automation and to provide visual communication between heterogeneous elements is page make-up. The purpose of the page makeup is to connect all the elements with each other visually, to make them compatible and proportionate, and to arrange the material on the strip visually [8].

On the page of the forthcoming edition, text and graphic information is subject to certain rules [9, 10]. The formation of text information on a page, a paper sheet, is

carried out in a certain way by organizing into a system of individual components. In this case, the composition strip, the page spread, and the editions generally act as a system of interdependent elements and form a single unit. Structuring of the text, its integrity is achieved by means of its "significance" organization.

The features of the text material are related to the internal structure-forming factors, because they are integral factors in the condition of the formation of the edition text pages. The text material is usually the basis of the edition design [11].

In addition to the internal factors, the text part of the edition is influenced by the external structure-forming factors that are associated with the destination of the printed matter. The edition must always meet consumer requirements. The formation of a text message on a page depends on the reader's categories, it should be related to the age, psychological and other characteristics of the consumer, meet his educational background. In addition, external structure-forming factors are related to the conditions in which the edition is used, aesthetic ideals, the economic possibilities of the reader, etc.

The structural construction and harmonious unity of the text material in the edition is achieved by certain principles of composition. They are implemented by the repetition of the whole in parts, the subordination and ordering of elements and their groups, the proportionality, the established uniform measure, the equilibrium, unity and integrity of pages, parts of the text [11].

Proportions express the qualitative interconnection of parts in the whole. Proportions are the most important when determining the format of a book page, a folding page surrounded by margins. Proportional rules are at the heart of the system of letter size, the size and location of text blocks. Any element of the text information must be consistent with the page format. In particular, the attention is paid to the size and proportions of the alphabetic characters on the page, the line length, the column height, the tables proportions [12]. It can be noted that proportionality is one of the most important principles of the composition art. The proportions of the letters, which are determined by the ratio of the main and additional strokes, notches, contrasts, are inseparable with the concept of proportionality. Proportionality influences the size of inter-word spaces, paragraph indents, font sizes, interlining.

In the broad sense, based on the above, we can talk about the systematic approach that is necessary for the design of the edition text material [12]. The structure and properties of the composition elements make it possible to see it on the page as a whole. Moreover, the properties are characterized by a set of parameters, some of which may have a quantitative measure (size, page format, etc.), while others are expressed only qualitatively (aesthetic characteristics, composite solutions) [8].

The introduction of automation systems for prepress processes [2, 4] requires more than it is acceptable in conventional technologies to use typical techniques and design elements for printed pages and the editions in general.

Based on such principles, a standardization methodology is designed. It uses techniques such as:

- simplification – reducing the number of solutions (for example, formats) in the manufacturing process to a number sufficient to meet the needs of the consumer;

- unification – a combination of conditions that results in the use of a limited number of individual elements in manufacturing (for example, fonts);

- typization – developing typical layouts or process technologies based on common characteristics for a range of features.

The essence of typization lies in the development and use of technological processes, not for individual editions, but for types of editions, comprehensively addressing the technology issues common to a particular type. Typization is based on the establishment of typical representatives (models), which have the highest number of features characteristic of this type of editions.

Publishing books, brochures, promotional materials, etc., is based on the use of standardized and typical methods and it allows not only to apply a limited amount of equipment and software products, but also to develop the optimal (for specific conditions) process of editions publishing while simultaneously implementing the whole complex of typical solutions for a future book, magazine, brochure.

The main purpose of automation in the publishing and printing environment, the unification of standards between the prepress, printing and postpress stages is to ensure the optimum workflow, which minimizes, and ideally prevents, the impact of the human factor on errors in all its stages [2]. Therefore, the gradual introduction of automation is recommended to start with the editorial staff, making coordinated demands to printing houses, namely that in the first stages this approach requires less money and is more efficient in terms of establishing an industry standard for processing the text and illustration information [9] and manufacturing printing matter [2].

Taking into account the advantages and limitations outlined, publishers who are clearly aware of the need for automated publishing systems must consider the high level of complexity of certain products and choose experienced system integrators for implementation authorized by the developers and guaranteeing the required training and the certification quality.

3   Software development for multi-column edition design

Having studied the market of periodicals in Ukraine, for January 1, 2019, according to the State Statistics Service, 2617 journals and 6590 publishers were registered. Having analyzed the methods of editorial-technical preparation and the technology of periodicals manufacturing [6, 10], nowadays there is a task to create a software module for the automatic layout of large multi-column editions in order to reduce the complexity and time costs in publishing houses.

Layout software is used for the layout of printing editions, the most competitive on the market is Adobe InDesign of different versions. InDesign layout software is a powerful software tool for the layout of printing editions. However, the feature of the layout of multi-column editions requires additional capabilities. There are additional plugins on the market to create a modular grid for a future edition. However, they only perform mathematical calculations and divide the composition strip into a given number of modules, without taking into account the inter-column distance or with a fixed one.

Despite the advantages of this software (the focus on all printing products and not only, obtaining high quality text and graphic material, etc.), it has several disadvantages:

- high cost, $ 436 per year for using a licensed version of Adobe InDesign CC for a period of 1 year [2];
- high PC requirements – Recommended 8GB RAM, minimum free hard disk space – 2.6GB;
- a wide range of tools that are not applicable for multi-column layout with a small volume of illustrations;
- the inability to use the free trial version in commercial entities;
- the working complexity for a beginner;
- it requires the active involvement of a designer, all parameters are set manually, only the strip division into the specified number of columns is done automatically.

Using the developed software module will allow to carry out the layout process with the use of automatic selection of optimal parameters for a page and an edition as a whole. In-depth analysis of the text and graphic material, its volume and the subsequent calculation and the automatic parameter selection will also be carried out.

The software module has several advantages:
- low cost;
- PC requirements – 2GB of RAM is recommended, it does not require a lot of hard disk space to install – up to 500Mb;
- a logical and understandable interface of the software;
- an automatic layout process with the involvement of a designer for the input of data, graphic material, the implementation of quality control of the completed material.

Table 1. A comparison of the software module with the most competitive software.

Loss function's type	Automatic parameter selection	Construction of modular grid	Automatic layout control	PC Require- ments	Free trial	Cost, per year
Adobe InDesign CC	-	manually	-	high	7 days	436$
Grid Calculator Pro Edition	-	automatic	-	high	-	165$
Software module	+	automatic	+	low	1 month	100$

The market requires the rapid implementation of high-quality layout of large volume material for printing products, including multi-column ones. The software module provides the ability to perform the procedure promptly, automatically, qualitatively, in compliance with all standards of composition and layout.

In the layout process of multi-column editions, especially large ones, there are many technical issues based exclusively on the rules of technical documentation, such as determining the optimal font parameters of the text information, the edition page, and the edition as a whole. The selection of these parameters is simple but time-consuming. If you select certain properties and parameters of the text material after the layout, if the material does not correspond to the selected area of the strip for it, that is, it occupies a larger or smaller area, you need to change the parameters and make the material layout again. The same situation arises in the proportionality of the main and additional text, as well as the headings and subheadings of different levels.

Using the developed module will allow one to create an edition modular grid quickly and technically correctly, based only on the technical standards and rules that are embedded in the base of the construction algorithm. Also one can carry out the layout process using the automatic selection of optimal text parameters, based exclusively on DSTU, standards and rules of layout.

In the process of designing the module, the main goals are:
- the need to develop a software module for the automatic layout of multi-column editions;
- the adaptation and cross-platforming of the module with all layout software;
- the autonomy of the module work;
- the approbation in institutions of higher education in the disciplines studying the layout software;
- the approbation of the module in publishing houses;
- obtaining a copyright for a computer software.

4   The basic principles of the software module operation

The fundamental novelty of the software module is an automatic formation of a "smart" flexible modular grid, the construction of which takes into account the technical and technological features of the edition. The module allows implementing an automatic layout process, changing the default options of the layout process. Compared to layout software, the software module has a much lower cost and more functionality for multi-column editions, and a larger range of settings and the ability to work with large databases compared to specialized plugins.

The algorithm of design and selection of technical properties is based only on the data of regulatory documents, and provides aesthetically attractive and technically competent layout.

Fundamentally new features are the creation of:
- an automatic software module;
- an algorithm that will select the text parameters accurately;
- a sub-module for automatic text filling;
- a sub-module for the edition layout control.

The software module will significantly reduce the layout time of large and medium-sized editions with a small content of illustrative material, which will greatly reduce and optimize the time of prepress preparation.

The technical advantages of the software module are:
- an automatic selection of optimal parameters of text material, a page and an edition as a whole;
- maintaining the proportionality between the main text, the additional text and the headings of different levels and sublevels within the layout rules;
- an automatic construction of a modular grid as a layout template in accordance with GSTU;
- an automatic layout process in accordance with the standards and rules of layout;
- use of both as an autonomous unit and in a plugin mode;
- cross-platforming.

The disadvantage is the lack of automatic graphic content filling. You need to involve a designer to work with it who also performs the final quality control.

The created software module provides an automatic layout of multi-column editions with a small volume of illustrations (up to 5%), large and medium volume and the text of the first and second complexity level.

The module uses cloud-based storage facilities with remote access, which contain a database of regulatory and technical parameters. The use of this technology makes it possible to operate the module fully, even on computers which are not sufficiently powerful with connection to not ultrafast Internet.

The software module works both as an autonomous unit and in a plugin mode, and the technical adaptability and cross-platforming of the module allows the collaboration with various layout programs.

The software module interface is simple, concise, functional and intuitive, allowing any users to work with the module.

The module contains submodules with their control intermediate points, if all the specifications are satisfied, the algorithm goes to the next sub-module, if not, an automatic selection of characteristics is done. The next move will not be completed until the previous sub-module process is finished.

The sub-modules organize the work in the following stages:
- the construction of an edition modular grid;
- the selection of optimal technical parameters;
- the text content filling;
- the implementation of the layout control.

When creating a new document, the user selects a template from the database or manually enters the parameters of a future multi-column edition:
- a format;
- a number of columns;
- a layout;
- a font type.

Based on these parameters, a modular grid is constructed, and the optimal inter-column distance is automatically determined to the column format. The layout of the future edition is displayed, with vertical lines dividing the composition strip into vertical modules, the number of which corresponds to the columnarity of the edition.

At the stage of selection of the optimal technical parameters, the algorithm performs the analysis of the composition strip of the column, and on the basis of the reference data determines the optimal font size, thus providing good readability and aesthetic appeal. According to the size of the font and the format of the default composition strip, the algorithm determines the optimal interlining, and in accordance with it, divides the composition strip into horizontal modules whose height corresponds to the interlining. The result is an intersection of horizontal and vertical lines that form a modular grid that will ensure the layout.

Although the software module does not automatically fill the layout with graphic content, but the designed modular grid gives a clear understanding of where to place the illustration (it corresponds to the multiplicity of modules in height and width of the composition strip), and strictly determines the size (the height should be multiple to the size of the interlining, and the width must clearly correspond to the width of the vertical module or several modules).

The text material is added to the layout via the text import option. Doing this, the module nullifies all the properties of the text and assigns the parameter to the font size, which was calculated as the optimal one before. The designer can adjust it manually, however, it should be remembered that the algorithm is clearly based on the technical documentation: DSTU 3772: 2013 Originals for printing reproduction. General technical requirements; GSTU 29.1-97. Journals. Printing implementation. General technical requirements (amended on March, 15, 2000), etc.

The sub-module of the text content filling also controls the automatic proportionality between the main and additional text, as well as between headings and sub-headings of different levels. The filling algorithm is based on the rules of composition and layout of the text, taking into account the features of the edition.

The sub-module of the layout control monitors the following parameters: the conformity of the font, the size and font type, homogeneity of paragraph indents throughout the text, the proportionality between the text and headings, kirking and trekking indicators, the presence of "corridors", the length of end-of-line paragraphs, the number of transfers in the paragraph, the transitions from odd to even pages, incomplete finite lines at the beginning of the strip, incomplete paragraph lines at the end of the strip.
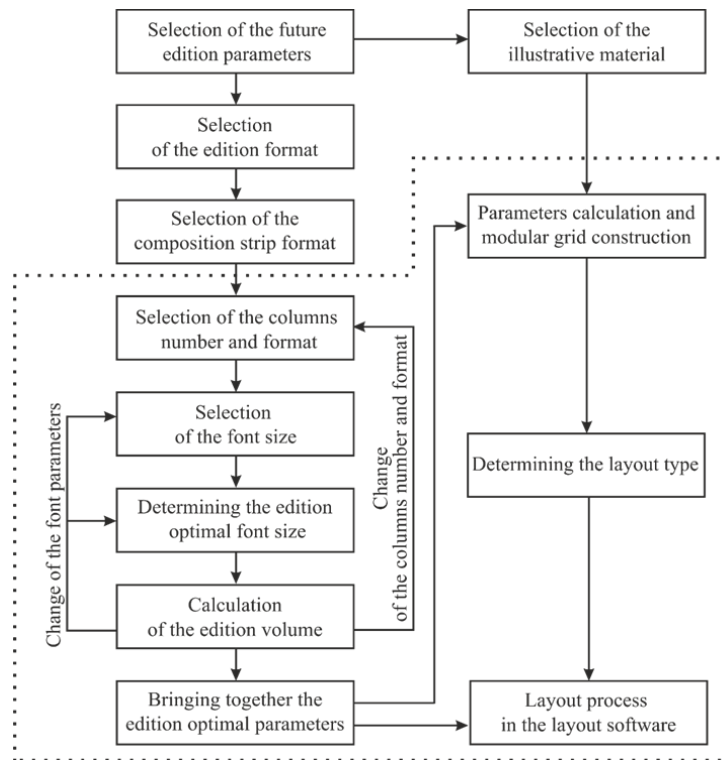
Fig. 1. The algorithm of conventional technology of the editorial and technical process of the prepress preparation of a multi-column edition.

Also the same type of headings of the same degree of rubrication with the same number of lines is monitored.

The designer receives an automatically completed text, with assigned optimal parameters and inserts the illustrative material. According to the algorithm, the text material layout is made again, with the exception of the modules where the illustrations are placed. But the layout is controlled once again.

At the end of the process, the designer evaluates the aesthetic appearance of the strip composition, the page spread and the edition as a whole.

The software module allows one to print the completed material, post it on the Internet, or send it directly to the specified e-mail.

In Figure 1, the algorithm of conventional technology of the editorial and technical process of the prepress preparation of a multi-column edition is presented, and Figure 2 shows the optimized technology using a software module.
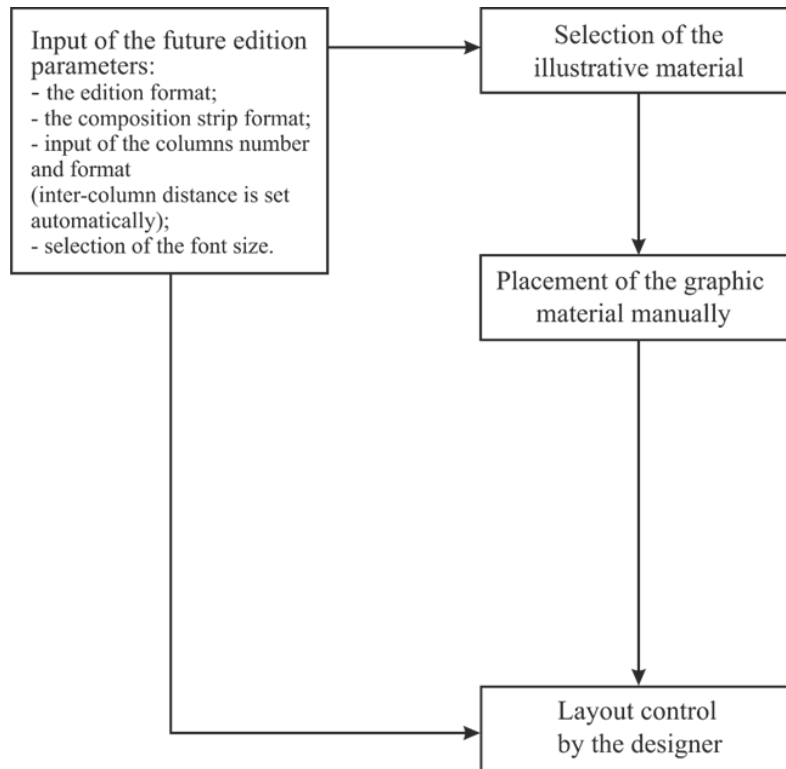
Fig.2. The optimized technology with using a software module

The separated area in Figure 1 presents those operations, which under conventional technology are carried out manually, and when using the designed software module will be performed automatically. Therefore, it is obvious that using the module reduces time costs, lowers the complexity and optimizes the process of prepress preparation.

5 Conclusion

Using the developed module will allow to correct the automatic layout of multi-column editions quickly and technically correctly, based only on the requirements of regulatory documents and rules of layout.

The developed software module will effectively enter the market due to low cost, the users with different training level will be able to evaluate the reliability, consistency and logic of work with the module. The obtained in the output quality material in the short term will be the best indicator for the application of the developed module. Pretesting in schools and publishing houses will eliminate the shortcomings and optimize the process, making it more user-friendly.

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