MULTILINGUAL GRAPHICAL AUTHORING EDITOR IN A DISTRIBUTED e-TESTING CLUSTER – DeTC

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This paper describes a multilingual graphic editor for creation of circuits, drafts and graphics in such subject areas where it is possible to pre-define the composite graphic elements. The database with testing questions stores only the indices of the composite graphic elements, their coordinates, size and the connections among them. As a result we have a substantial decrease of the size of the database, the data transferred to the learners and, consequently, the time required for visualization of the testing questions on-line. Another important contribution is the opportunities to dynamically generate circuits, drafts and graphics in a number of cases, thus decreasing the number of questions, authored in advance. The graphic editor is developed as an extension to the Dynamic Test Development Tool in Distributed e-Testing Cluster. It is multilingual, i.e. all the elements of the user interface (menus and buttons) are parameterized, with the actual texts of the supported languages stored in the database.

1. INTRODUCTION

The explosive growth of the Internet is making available radically new means of communication that affect such diverse areas as business, entertainment and education. While older methods of accomplishing tasks continue to be used, the Internet offers unique advantages. In areas of education it offers a medium that has the potential to be more responsive to students, to encourage greater access to different sources of information than traditional methods offer [1, 2, 9]. Many universities, organizations and companies started to use the World Wide Web and to adopt their computer testing systems in order to create web-based assessment and testing systems (WATS).

The classic test is a sequence of precisely defined questions, with each question suggesting a simple answer, which can be easily checked and assessed as correct, incorrect or partially correct (for example, incomplete).

Questions are often split in types, according to the expected answer:

- classic type of question – with a "yes/no" answer;
- multiple-choice question – one answer (MC/SA, Multiple-Choice/Single-Answer);
- multiple-choice question – more than one correct answer (MC/MA, Multiple-Choice/Multiple-Answer);
- free-type questions- with the answer being a number or a text;
- others.

Most of the existing Web-based systems for testing and assessment provide technologies and tools for creation, submission and assessment of questions of the

first three types [3, 4, 5, 6, 7]. A certain number of systems process all types of questions [8, 10, 13].

However, most of the latter support materials with insufficient mathematical contents. The tests authors have to create the formulae and equations with a separate tool and convert them into a GIF/JPEG format and include them in the testing system as a graphic, when more complex mathematical or engineering content is required.

This approach significantly increases the size of the database, which stores the testing questions, as well as the size of the information transferred to the learners, because of the large number of images.

On the other hand, it does not provide a solution to the problem for dynamic creation of questions, which forces the development of a large set of test versions, in order to prevent the test from being learned by heart.

In [13] is described how dynamic free-type questions with engineering or mathematical contents are created, generated and applied in practice at a Distributed e-Testing Cluster – DeTC. Learners are given unique testing questions by generating random values for the variables in the question. This does not increase the number of the preliminary created questions, and further decreases the size of the database with tests, and minimizes the size of the transferred information.

It is common for many different areas that various graphic elements are used when testing questions are created. The preparation of those graphic elements with the standard drawing systems costs significant amount of time to the authors, while the storage in GIF / JPEG format results in a weighty increase of the size of the information stored, and it also slows the visualization of the questions during web-based learning and testing.

This paper describes a multilingual graphic editor for creation of circuits, drafts and graphics in such subject areas where it is possible to pre-define the composite graphic elements. The database with testing questions stores only the indices of the composite graphic elements, their coordinates, size and the connections among them. As a result we have a serious decrease of the size of the database, the data transferred to the learners and, consequently, the time required for visualization of the testing questions on-line.

Another important contribution is the opportunities to dynamically generate circuits, drafts and graphics in a number of cases, thus decreasing the number of questions, authored in advance.

This approach is experimented and is being successfully applied in preparation of tests for the education in Physics, Electronics, Electrical Engineering, Local and Global Area Computer Networks, Computer Systems and Architectures, etc.

DeTC [11-13] is being developed as a joint project of the ECE Department at the University of Limerik – Ireland, the Humboldt University in Germany, the Laboratory for Electronic Trade (ECL), the departments of Computer Technologies and Computer Systems at the University of Plovdiv, Bulgaria, and the department of Informatics and Statistics at the University of Food Technologies, Plovdiv, Bulgaria.

2. CREATION OF GRAPHIC PRIMITIVES

The graphic editor extending the functionality of the Dynamic Test Development Tool in Distributed e-Testing Cluster – DeTC enables the creation, insertion, modification, deletion and storage of graphic primitives for various subject areas, partitions, chapters and parts of them.

There are three types of graphic primitives: primary (specific for the subject area), marking (letters, special symbols, constants, etc.) and connecting (lines, arrows, etc.). For example, in the schemes on figure 1, the primary primitives are circles, rectangles, points; the marking ones are the Latin letters U, A, V and R; connecting ones are segments, rectangular segments and arrows.

1) 2)

Fig. 1

Graphic primitives are created through the use of standard (prepared in advance) graphic primitives like rectangles, ellipses, arrows and others, as well as by manual drawing. It is possible to create new graphic primitives out of existing ones by copying (including from an URL), editing, filling with color, sectioning and merging.

The hierarchical storage of graphic primitives by subject areas, partitions, chapters and parts of them enables authors to choose from a reduced selection of graphic elements when preparing schemes, drafts or graphics for a test.

3. CREATION OF SCHEMES AND DRAFTS

It is fairly easy to create schemes and drafts with the dialog-based graphic editor. Authors have only to select the locations of the primary and marking graphic primitives and to interconnect them with connecting primitives.

To insert a primary or a marking graphic primitive, an author has to describe or point out with the mouse the co-ordinates of the point, which will be the center of the graphic primitive, the rotating angle and how to scale it – horizontally and / or vertically. It is also possible to achieve this by stretching the graphic primitive with the mouse.

It is then necessary to select which primary and marking graphic primitives will be connected and the connecting graphic primitive (section, dotted section, arrow or something else existing) to do it. DeTC automatically generates a connection matrix for the primary and marking graphic primitive in the scheme or draft, which is not visible by default. The elements of the connection matrix are the unique numbers of the connecting graphic primitives. It is possible to change the connections between the primary and marking graphic primitives by editing the connection matrix itself.

For each scheme or draft the database stores only information about the primary and marking graphic primitives used: number, co-ordinates of the center, rotation angle, horizontal and vertical scaling. Of course, the connection matrix is stored as well, but linearized, because in most of the cases it is a rarefied matrix.

Authors can put one or more schemes and / or drafts in one testing question. Schemes and drafts can be copied, inserted, modified, erased, scaled and rotated. For example, the second scheme on figure 1 can be created out of the first only by exchanging the co-ordinates of the marking graphic primitives A and V.

When a scheme or a draft is modified, all co-ordinates of the participating primary and marking graphic primitive are recalculated, because they are relative to the lower-left corner of the scheme or draft. The latter is (0,0) by default. The testing questions database stores the number, the unique numbers and the co-ordinates of the participating schemes or drafts (compound elements).

4. DYNAMIC CREATION OF CIRCUITS AND DRAFTS

The dialog-based graphic editor supports dynamic creation of circuits and drafts where possible. Authors have to define which of the consisting primary or marking graphic elements are static and which ones are dynamic, by transforming the connection matrix into a permissible-connection matrix.

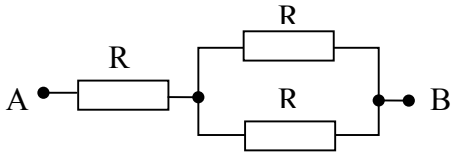

Fig. 2

Within the latter the dynamic graphic elements are marked with one on the main diagonal (by default it is zero, i.e. by default the graphic elements are static). In dynamic creation of circuits and drafts the type of the connecting graphic element (bold, pointed, etc.) is inherited.

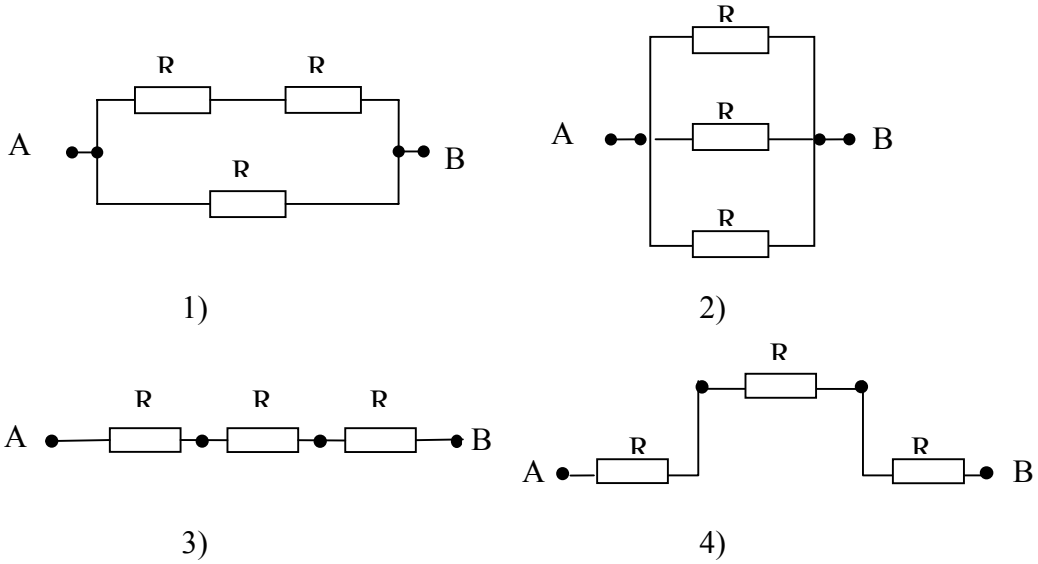

Fig. 3

For example, in the testing question "What is the equivalent resistance between point A and B on the circuits from figure 2?" points A, B and the ending bold points can be defined as static, and the rest graphic elements – as dynamic. When the help of a specially created heuristic algorithm DeTC will generate a number of questions with the same text and similar circuits, part of which are shown in figure 3.

Dynamic creation of circuits and drafts significantly decreases the number of questions authors have to create in advance and further decreases the volume of the stored and transferred information.

5. CONCLUSION

A syntactically oriented editor is created to facilitate authors of tests – Dynamic Test Development Tool (DTDT), as an extension of the existing in DeTC editor Test Development Tool (TDT) [11]. DTDT features an easy and convenient dialog-based user interface for writing engineering and equation, circuits, drafts and graphics; for defining the dynamic variables used; for defining the dynamic answers; for defining the body of the dynamic questions with or without dynamic schemes and drafts and for additional design of the questions screen.

Fig. 4 shows a principle diagram for developing and generating tests with dynamic questions with dynamically created circuits and drafts.

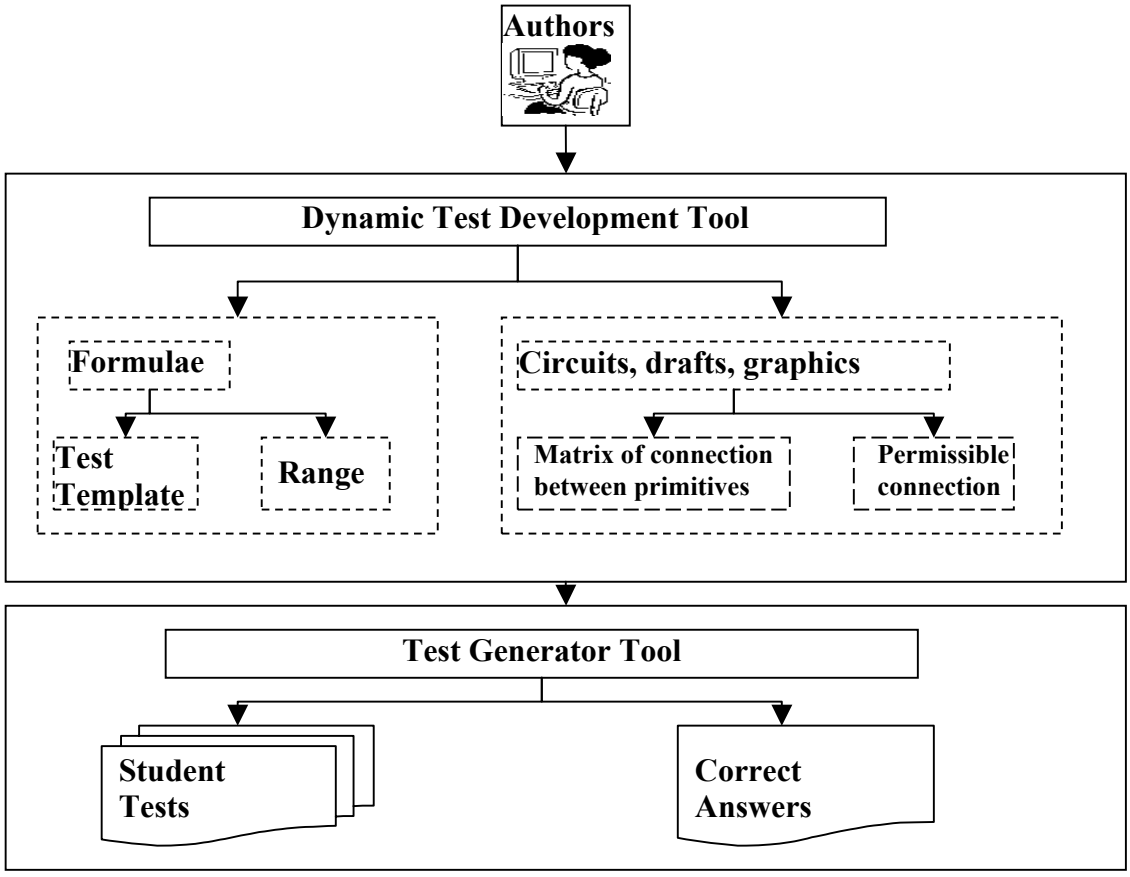

Fig. 4

DTDT is multilingual authoring tool, i.e. all the elements of the user interface (menus and buttons) are parameterized, with the actual texts of the supported languages stored in the database. In this way it is possible to carry out the interaction with the authors of testing questions in the language they choose out of the preliminary defined ones – Bulgarian, English, German, French, Greek, or some other existing in the database language.

This approach is experimented and is being successfully applied in preparation of tests for the education in Physics, Electronics, Electrical Engineering, Local and Global Area Computer Networks, Computer Systems and Architectures, etc.

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