INTELLIGENT SYSTEM FOR AUTOMATED ASSESSMENT OF TEST TASKS SETS CONFORMITY TO SEMANTIC STRUCTURE OF EDUCATIONAL MATERIALS

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In the modern educational process, much attention is focused on improving the quality and efficiency of educational materials, in particular, test tasks, which are a valuable tool for assessing students' knowledge and understanding. However, it should not be forgotten that conventional evaluation methods are usually limited only to checking the correctness of answers without taking into account the semantic connection and context [1, 2]. As a result, it can lead to less objective results and ineffective use of educational materials.

The method of automated evaluation of the case of test tasks to the semantic component of educational materials is based on the intellectual analysis of the textual content of these materials. It uses computer algorithms and natural language processing techniques to determine the semantic relationship between test tasks and learning materials [3]. This method allows to automatically determine how well the answers to the test tasks correspond to the content and semantics of the educational materials.

Intelligent system for automated assessment of test tasks set conformity to semantic structure of educational materials is built on the basis of the method of automated assessment of test task case conformity to the semantic structure of educational materials. The scheme (Figure 1) helps to better understand the work with the intelligent system and schematically depicts the optimal sequence of task performance.

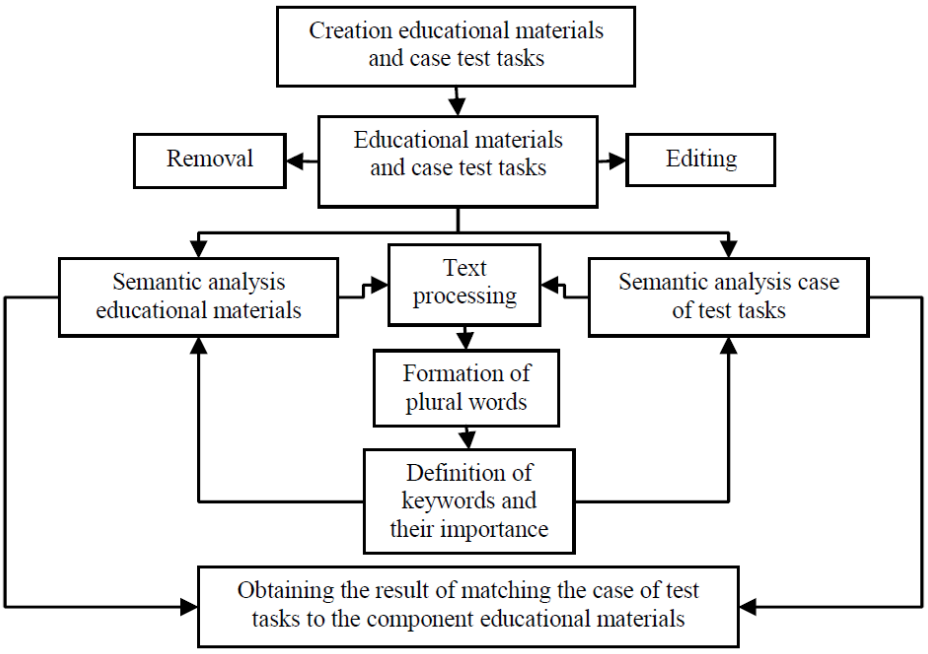

Figure 1. Generalized scheme of functionality of intelligent system for automated assessment of test tasks set conformity to semantic structure of educational materials

According to the above scheme, it can be seen that the primary stage in the application is the input of data by the user. That is, the creation of informative educational materials and case test tasks. After their creation, such functions as: deleting educational materials, editing them, or carrying out semantic analysis will be available to the user. The "semantic analysis" function consists of several stages: lemmatization of the text (removal of punctuation marks, reduction to lower case, removal of stop words), formation of the set of words (breaking the text into words), and then determining key words and their importance. And the final function that is available to the user is obtaining a result, that is, finding an assessment of the correspondence of the case of test tasks to the semantic component of the educational materials.

To visualize the architecture of the developed software application, the intelligent system for automated assessment of test tasks set conformity to semantic structure of educational materials scheme was developed (Figure 2).

According to the scheme given above, the subsystem of the user's work with data is responsible for the user's ability to add new informational and educational materials and relevant cases of test tasks, edit and delete them. All changes will be made and saved in files accordingly. The data pre-processing subsystem accepts already ready-to-process data that is available in the database and prepares it for further semantic analysis. But the semantic data analysis subsystem accepts data processed by the previous subsystem as input, and thanks to its function, it allows the user to automatically generate keywords, determine their importance, and evaluate the compliance of the case of test tasks with the semantic component of the educational materials and, as a result, display the result.

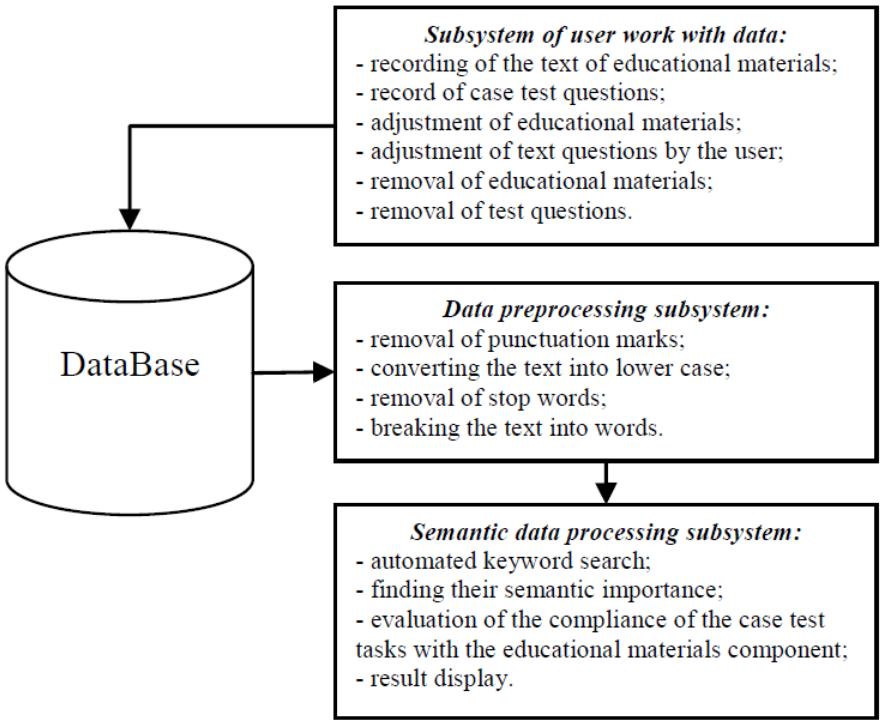

Figure 2. Scheme Intelligent system for automated assessment of test tasks set conformity to semantic structure of educational materials

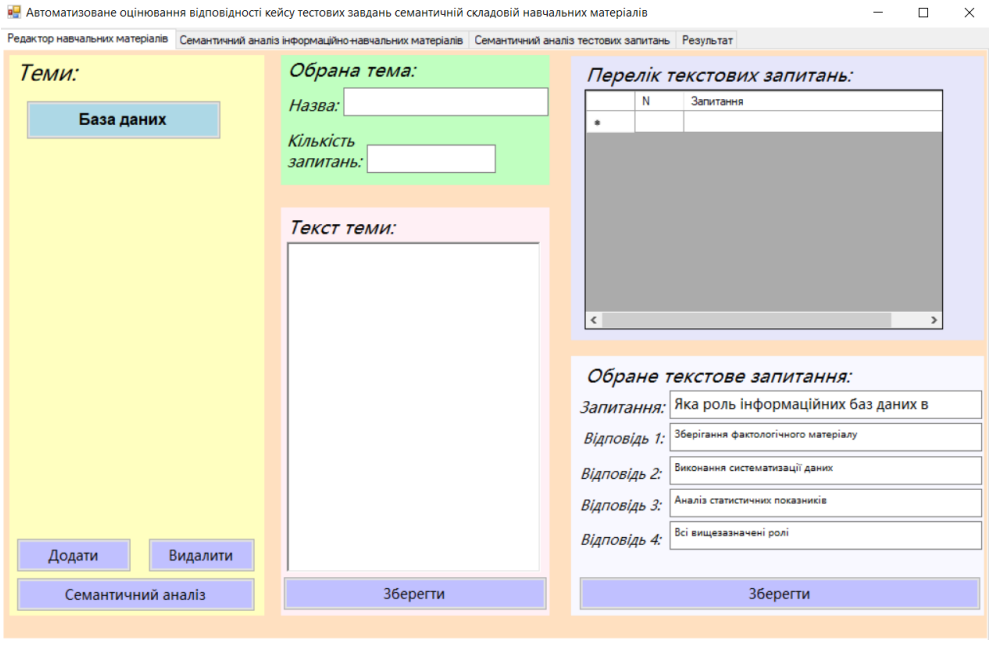

Figure 3. Screenshot of the first tab of the intelligent system for automated assessment of the compliance of the case of test tasks with the semantic component of educational materials

The intelligent system for automated assessment of test tasks set conformity to semantic structure of educational materials accepts the selected text of educational materials as input, as well as a case of test tasks that corresponds to the selected topic. For the relevant purposes, a special editor of educational materials was created in the

application (Figure 3). After all the content of the initial materials and test tasks has been displayed on the form, the user can edit them. That is, to make changes to the text of educational materials and save these changes. You can also edit test questions.

After receiving input data, their processing begins. First is the filtering of educational materials. Filtering includes removing punctuation marks and numbers, as well as converting all text to lowercase. After that, vectorization of the INM content takes place, i.e. transformation into an array of words. The same stages are used for case test questions as for study materials.

Having received two lists of words, intelligent system for automated assessment of test tasks set conformity to semantic structure of educational materials starts their semantic analysis. That is, a set of keywords for educational materials is formed using the DE method [4]. The first stage is the formation of a set of original words. After that, stop words such as prepositions, pronouns, numerals and conjunctions are removed from the text. Next, the distances between words and the calculation of importance using DE are calculated for the training materials (Figure 4), and the number of original words is calculated for the set of test tasks (Figure 5). After that comes the formation of a set of keywords.

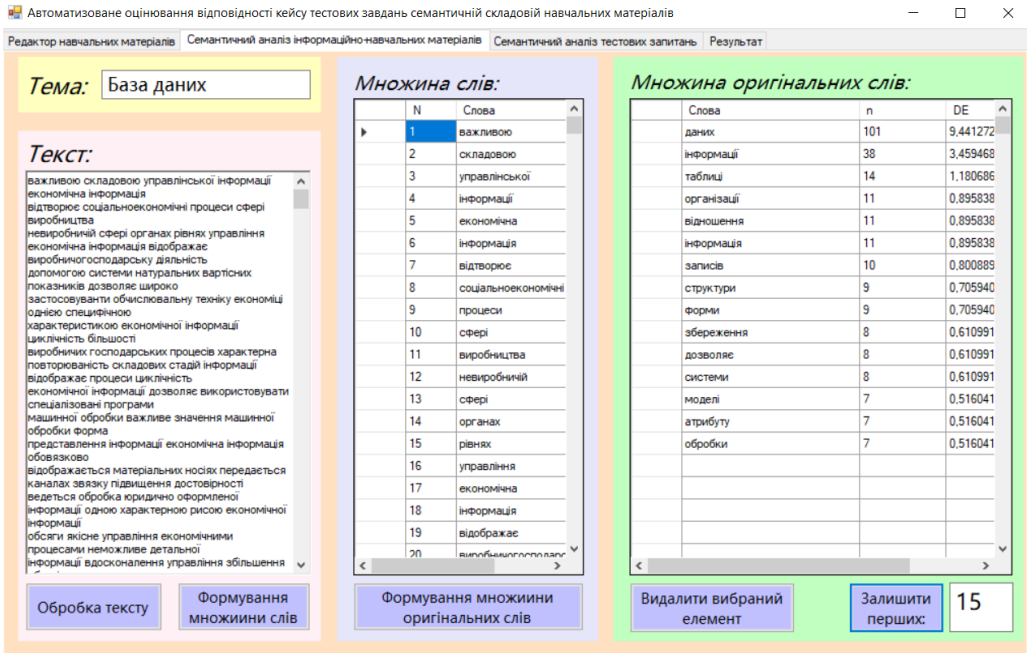

Figure 4. The result of the semantic analysis of educational materials

After the Intelligent system for automated assessment of test tasks set conformity to semantic structure of educational materials receives the key terms of educational materials and the key terms of a set of test tasks, it moves to the last stage - the comparison of the conformity of the case of test tasks with the semantic structure of educational materials. Intelligent system for automated assessment of test tasks set conformity to semantic structure of educational materials checks whether all important terms contained in the educational materials are present in the test questions.

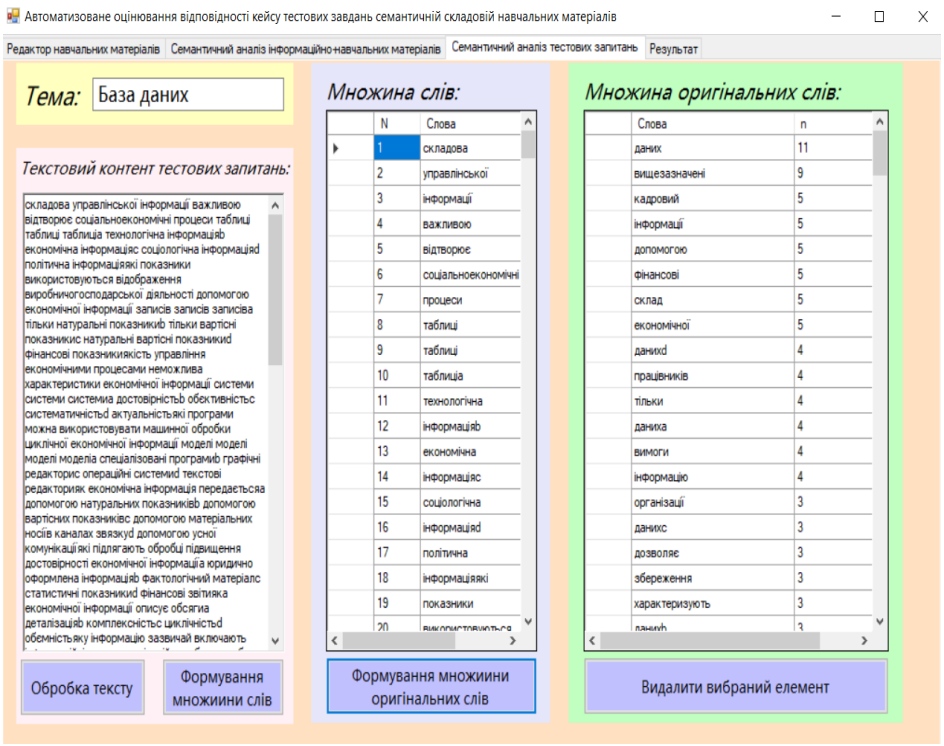

Figure 5. Result of semantic analysis of test tasks set

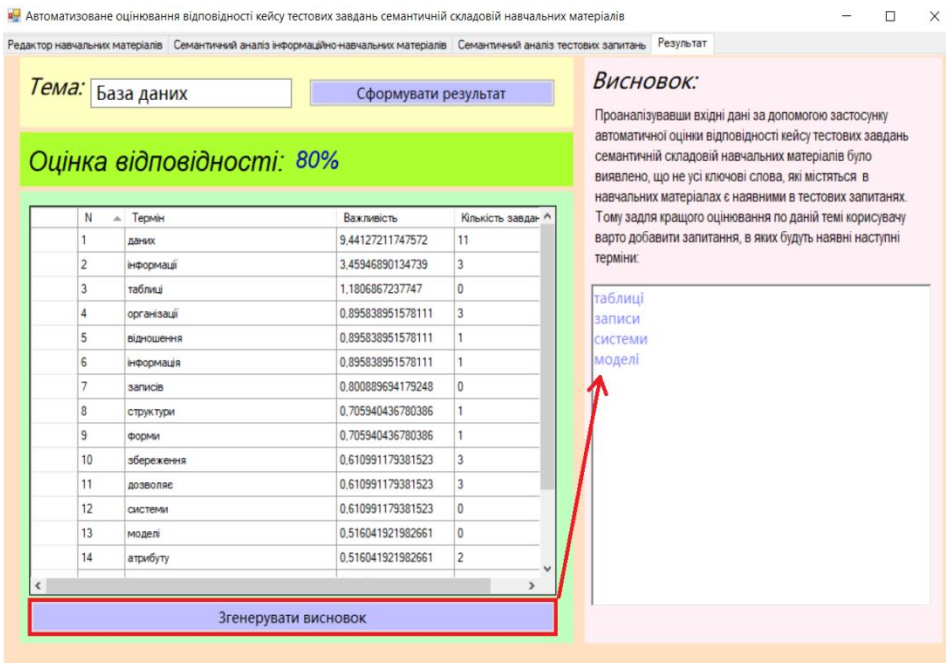

Figure 6. The result of the analysis of the compliance of test tasks set to educational materials

The output data of this intelligent system for automated assessment of test tasks set conformity to semantic structure of educational materials is a digital assessment of the conformity of the case of test tasks to the semantic component of educational materials based on the intellectual analysis of their text content. Also, the user of intelligent system for automated assessment of test tasks set conformity to semantic structure of educational materials can also receive an expert opinion of the program with a

recommendation on which key terms from educational materials should be included in the content of test questions. To do this, he needs to click on the "Generate conclusion" button (Figure 6). After that, the final result of the work intelligent system for automated assessment of test tasks set conformity to semantic structure of educational materials will take the following form.

After developing the intelligent system for automated assessment of test tasks set conformity to semantic structure of educational materials, a class diagram was obtained (Figure 7). From the figure you can see that the main classes in this application are the class "Form1", "Text Processor", "Read Text", "Semantic".

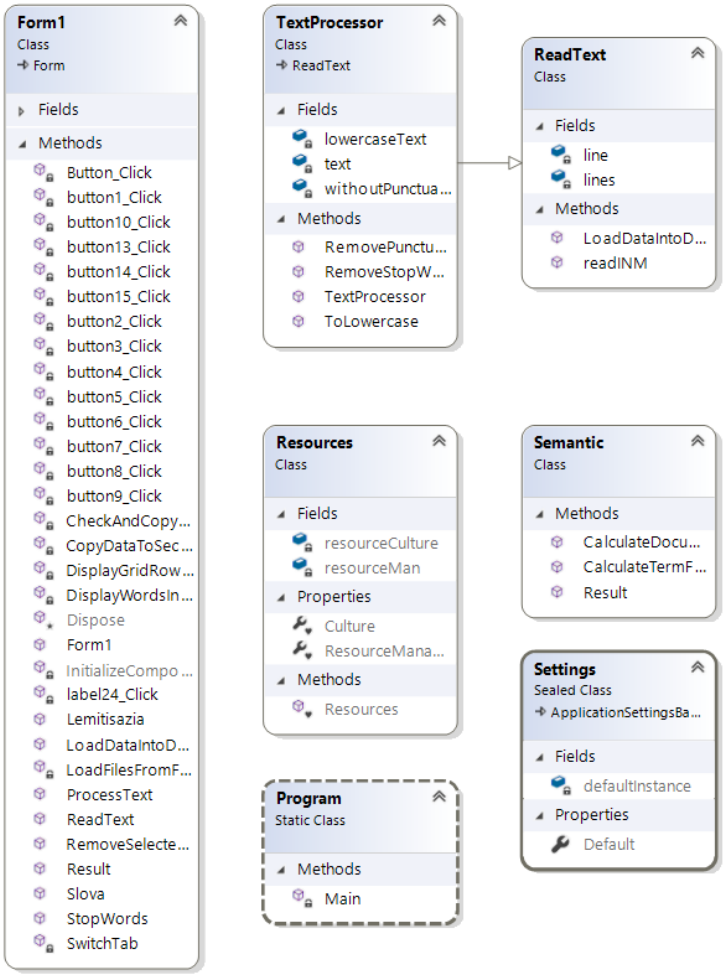

Figure 7. Class diagram of intelligent system for automated assessment of test tasks set conformity to semantic structure of educational materials

The "Form1" class is the main one in this application, and it contains the methods of many form components. The class contains a private field folder Path, which is responsible for saving the path to the folder with files. This class implements the ReadText() and LoadDataIntoDataGrid View() methods, which implement data output to the corresponding DataGridView components. Also, the class contains methods that are called when a button is pressed, these methods respectively perform the functions for which each of the buttons is responsible.

The "ReadText" class is responsible for methods of reading data from text files. The first method - raedINM(), is responsible for reading the text of informational and educational materials. Gets the name of the file, then creates a path to it and returns its contents as a string. The LoadDataIntoDataGridView() method is responsible for reading the test task case text. That is, the method reads data from the file line by line and returns their array.

The TextProcessor class is generally used to process input text. The RemovePunctuation() method removes all punctuation marks, ToLowercase() converts the text to lower case, and RemoveStopWords() removes stop words from the text.

The last class is "Semantic", it contains two methods for calculating TF and DE. The first method "CalculateTermFrequency" iterates through each term of the method and calculates a frequency score for it. The "CalculateDocumentImportance" method also iterates through each word of the text and calculates its importance using a variance score.

So, the developed intelligent system for automated assessment of test tasks set conformity to semantic structure of educational materials can have great potential during its use in educational institutions and organizations where it is important to assess the conformity of test tasks to educational materials. It will allow to automate the evaluation process and ensure the objectivity of the results.

To improve the intelligent system for automated assessment of test tasks set conformity to semantic structure of educational materials, the following areas of development can be considered: improvement of semantic analysis algorithms using more specialized methods, a more accurate algorithm for comparing text with test questions, and development of greater system functionality.

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