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DEVELOPMENT OF A METHOD FOR DETERMINING THE INDICATORS OF MANIPULATION BASED ON MORPHOLOGICAL SYNTHESIS

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Research on the development of methods for identifying signs of hidden manipulation (destructive information and psychological impact) in text messages that are published on Internet sites and distributed among users of social networks is relevant. One of the main problems in the development of these methods is the difficulty of formalizing the process of identifying signs of manipulation in text messages of social network agents. To do this, based on morphological synthesis, it is necessary to determine relevant indicators for analyzing text messages and criteria for making a decision about the presence of signs of manipulation in text messages.

Based on morphological synthesis, a method for determining manipulation indicators in text messages was developed, taking into account the achievements of modern technologies of intelligent content analysis of text messages, machine learning methods, fuzzy logic and computational linguistics, which made it possible to reasonably determine a group of indicators for evaluating text messages for signs of manipulation.

The stages of the method include evaluating the text message at the level of perception by the indicator of text readability, at the phonetic level by the indicator of emotional impact on the subconscious, at the graphic level by the indicator of text marking intensity, and calculating the integral indicator for making a decision about the presence of manipulation in the text message.

Based on the proposed method, specialized software was developed that provided 13 % greater accuracy in evaluating messages for manipulative impact compared to the known method of expert evaluations, which reduced the influence of the subjective factor on the evaluation result

Keywords: morphological synthesis, content analysis of text messages, target audience, manipulation, information and psychological impact

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1. Introduction

The rapid development of information and telecommunication technologies has led to the emergence of an information space with new communication capabilities. This resulted in the emergence of new information threats to the national security of the state. At the same time, information aimed at forming the consciousness of both an individual citizen and

the entire population of the country becomes the main tool for violating security.

So, specially prepared information is distributed in mass media under the guise of "fresh" news. The use of subconsciousness manipulation methods in the preparation of such news transfers them into the category of hidden destructive information-psychological impact (IPI). Gradual and purposeful dissemination of IPI in the information space can lead to an aggravation of the socio-political situation in the country, which is characterized by responses of public discontent [1].

To manipulate consciousness, reflexive control techniques are used. For this purpose, mass media provide information with various forecasts, versions, ratings, facts, and scenarios prepared in advance. Such information, being made public, can change the trajectory of events and even society in the direction necessary for the manipulator [2, 3]. This is possible by impacting the decisions of the main consumers of such information (at the strategic level – heads of state bodies). At the same time, in some situations, it is justified to familiarize secondary managers with the results of an analysis or forecast.

To undermine the authority of military-political administration in the eyes of the population, personnel of the armed forces, world society, an information field is used, where information is constantly updated, which may have signs of manipulative IPI. The results of content analysis of messages distributed in mass media indicate that the following methods are most often used for IPI on a specific target audience (TA) [4, 5]:

– belief in the inevitability of defeat (this increases the natural desire to be on the side of the winner);

– selection and tendentious emphasis of only positive or only negative facts, as well as the use of misinformation, false assurances, fictions and assumptions;

– presentation of an event, situation or issues that potentially cause uncertainty of the object of influence or force him to react accordingly (the relevant information, as a rule, discredits the enemy);

– use of offensive epithets and metaphors that cause a negative emotional attitude towards the selected object, associations with unworthy deeds of certain persons. The main purpose of such messages is to discredit the leadership, undermine the authority of the command, ridicule the style and methods of work of the commander, destructive criticism of his orders;

– exploitation of a positive attitude towards words like "will", "independence", "victory", "patriotism", "democracy" and the like to assert their views, assessments, and form intentions.

The above techniques have their own criterion for the effectiveness of manipulative IPI, in particular, the conviction of the object of impact (TA). This is a deep confidence in the truth of the ideas, concepts, images learned. It allows you to make unambiguous decisions and implement them without hesitation, to have a tough position in assessing certain facts and phenomena. Through conviction, people's attitudes are formed that determine their behavior in specific situations.

Therefore, a timely response to the dissemination of messages with signs of IPI is possible only through continuous monitoring of the information space. At the same time, monitoring tasks involve assessing IPI signs by content analysis of messages. A check is made for the presence of the methods (techniques) of psychological impact, characteristics of the target audience to which the IPI is directed, and other signs of consciousness manipulation in messages.

Text messages on social networks and news sites are an effective means of distributing IPI, which, thanks to the technology of organizing the exchange of information among users, are effectively used to manipulate the subconscious of large groups of the population. The process of disseminating information on a social network begins with the exchange of messages among its users who already have established connections (Fig. 1).

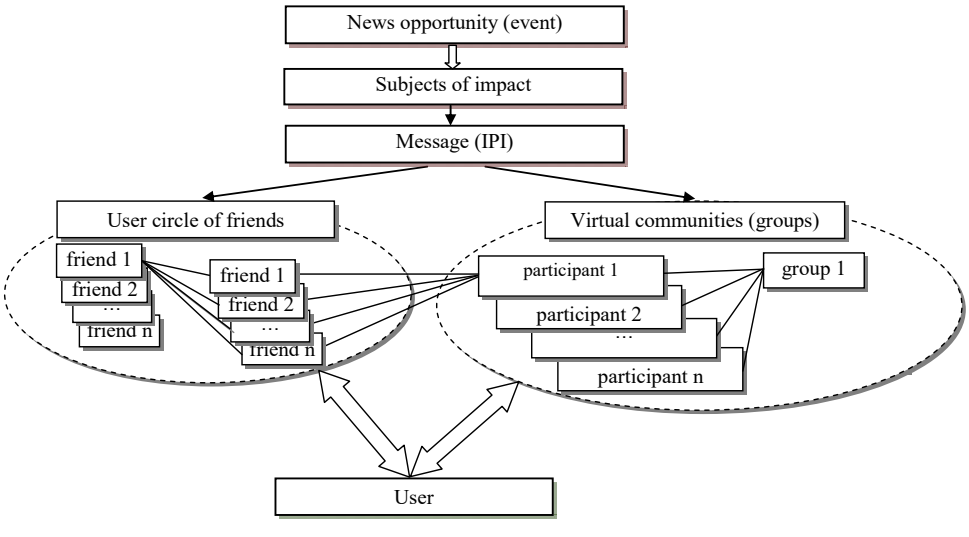

Fig. 1. Connections among users on social networks

Connections among users in most social networks can be represented by the following main types:

– direct, acquired by establishing direct contacts between network users. Social networking services are constantly expanding the possibilities of communication in the group of direct contacts due to the mass simultaneous distribution of messages of different content, private data exchange;

– indirect, due to the possibility of almost free access to direct contacts of network users with whom direct contacts are established. The social network has created conditions for expanding the circle of its direct contacts through indirect ones, depending on the interest of the impact objects;

– connections among group members, which are possible due to the mechanisms for combining users into groups (virtual communities) implemented in social networks. The group administrator creates a group profile similar to an individual user profile and sets rules for sharing information on it.

Free access to the user's personal information allows the subject of impact to more accurately send an IPI message (Fig. 2).

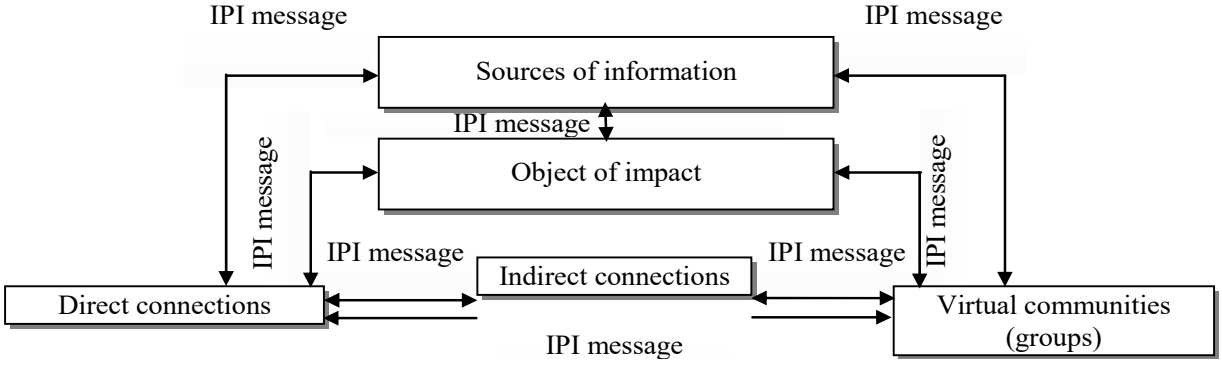

Fig. 2. Vulnerability of connections in social networks

Thus, in order to carry out a content analysis of a text message on social networks and news sites, it becomes necessary to develop a method for determining manipulation indicators. Such a method, unlike the existing ones, will take into account a set of sensational messages with morphological incidences. The definition of morphological incidences will reflect the structural escalation of the general manipulative IPI in relation to the objects of impact, which should be considered the main prerequisite for the development of the method.

2. Literature review and problem statement

The manifestations of manipulative IPI are very diverse by nature, which creates significant difficulties in its identification and evaluation. On the other hand, despite the practical importance of this issue, there is no systematic study of manipulative IPI in Ukraine. This occurs due to the imperfection of the corresponding theoretical base, the lack of necessary methodological tools, which requires an urgent correction of this situation. Based on the results of studies [6], a methodological approach was developed and criteria for assessing the level of destructive information impact on elements of the information infrastructure of the military sphere were substantiated. Such criteria can be used as the basis for the method of determining manipulation indicators, which, on their basis, allows one to draw a conclusion about the general state of the information space.

In [7], one of the methods for synthesizing dynamic systems with quasi-linear and temporal distribution of components is considered. Dynamic environmental monitoring systems use structural synthesis methods. Given the changing conditions in situations of consciousness manipulation, these methods provoke the creation of a morphological set for any information message. This ability requires a morphological classification of text messages.

However, this approach was not used to investigate the analysis of messages received by means of monitoring the information space due to the complexity of text content classification.

In [8], the expediency of using the phenomenon of the semantic triplet through the synthesis of means of psychology, linguistics, and ontological modeling is substantiated. The approaches presented in the paper make it possible to identify the sources of information-psychological (performative) impact on the addressee's mind, determine psychological factors of the dominant semantics of the text and the level of its performativity.

In [9], a fuzzy set decision support system is presented for automating the procedure for selecting a model to formalize interactions between actors in virtual communities and social networks. In this case, a system of fuzzy indicators for evaluating the elements of information impact is used.

The work [10] proposes an approach to detecting the activity of thematic Internet content in text messages based on statistical analysis. For this, it is supposed to determine the type of dependence of the frequency of occurrence of thematic content on the Internet on time. The selection of a systematic component (trend) is made by smoothing the time series by the least squares method with polynomials up to the sixth order. This makes it possible to increase the adequacy of the forecast for the development of information threats in the information space.

At the same time, the paper [10] does not consider aspects related to the identification of IPI methods in messages. Therefore, content analysis of messages remains an unresolved issue.

In [11], the authors proposed an approach to creating an automated Internet monitoring system. The functional flow block diagram of the automated Internet monitoring system is given. Among the system elements, there is a block for the content analysis of messages. Such a system will provide a complete, accurate and fast information retrieval through the means of effective search for relevant information; identification of implicit links between monitoring objects and related facts; visualization of research results.

However, the studies did not examine the process of detecting signs of IPI in messages. Only the order of automatic classification of messages by categories is specified.

Some scientific publications deal with the problems of using and identifying linguistic signs of manipulating public consciousness in mass media [12–17]. So, [12] discusses modern methods of content monitoring and content analysis of information flows. Attention is paid to attracting experts or specialists of special units to decide whether there are methods of consciousness manipulation in the text content.

At the same time, it was not taken into account that with constant growth of information volumes and the

development of consciousness manipulation technologies, the task of evaluating text messages by experts will be difficult. As a result, the efficiency of making a decision about the availability of manipulation methods is reduced.

In [13], methods of content analysis of Russian-language texts based on linguistic principles and methods of computational linguistics are proposed. The issues of forming emotion markers to determine the emotional tone of text messages were investigated. To develop a computer classifier, it is supposed to use an algorithm of machine learning from examples.

The peculiarity of applying this approach in practice is associated with the technical complexity of extracting information from large data sets, which requires the involvement of additional software and technical resources.

In [14], the author proposed a method for identifying signs of information impacts in social Internet services by content features. It is positive that a combination of two methods of semantic and latent-sematic analysis was used to solve the problem. Threats to information security are proposed to be identified by analyzing the links between the object of publication and the negative features of the object.

At the same time, [14] does not consider the issue of developing indicators for the presence of manipulation methods.

In [15], the main methods of manipulative impact are examined. The importance of studying linguistic signs of manipulation in social networks is substantiated, and their classification is carried out. Attention is focused on suggestion and persuasiveness, as the main types of manipulative impact on consciousness and subconsciousness, respectively.

At the same time, [15] does not provide a practical implementation of technologies for identifying signs of manipulation in social networks.

In [16], the authors proposed a neural network based on fuzzy logic rules to assess the destructive nature of text content in social networks. To build such a network, an assessment of the frequency of publications of a certain text and the emotional coloring of the text was chosen.

At the same time, there is no analysis of the features of using IPI methods in text messages and the possibility of identifying their signs.

The paper [17] considers the features of using NLP, Information Retrieval, SEO and Web-Minning technologies to determine set phrases when identifying keywords in the development of Web resources. In content monitoring, it is proposed to identify set phrases by linguostatistical analysis based on NLP methods. The determination of the degree of belonging to a set of keywords is carried out by a quantitative analysis of set phrases.

However, the proposed method can be applied to determine set phrases when identifying keywords only in Ukrainian-language content.

The results of the analysis of works related to the identification of methods of manipulation in messages distributed on the Internet [8–17] indicate that today there is no comprehensive approach to determining the methods of IPI in text messages. The use of indicators proposed in [8–17] does not imply further automated solution of the content analysis problem.

Thus, the need to develop a method for determining manipulation indicators based on morphological synthesis for automating the content analysis of messages is due to the effective use of hidden IPI in mass media. This task is of particular importance in the context of the emergence of new information threats to the national security of the state.

3. The aim and objectives of the study

The aim of the work is to generalize and formalize a system of indicators that will allow, through the development of appropriate software, automating the process of identifying signs of the use of manipulative technologies and propaganda in text messages.

To achieve the aim, the following objectives were set:

– to develop a method for determining manipulation indicators based on morphological synthesis to automate the content analysis of messages;

– to simulate the developed method for determining manipulation indicators based on morphological synthesis to test its effectiveness.

4. Materials and methods

The object of the study is the process of evaluating text messages for signs of manipulation.

The main hypothesis of the study is the assumption that the integration of methods for determining indicators of manipulation in text messages with subsequent automation will improve the accuracy of evaluating messages relative to known methods.

In the course of the study, it was assumed that the target audience is homogeneous in its composition, that is, each subject of psychological impact has the same properties of perceiving information in text messages, the same level of critical thinking, the same emotional perception of information. Only text messages are subject to content analysis studies.

The research methods used in the development of the proposed method are based on approaches to processing natural-language texts and methods of content analysis. The main difference between the known approaches to processing natural-language texts in order to automate the process of their analysis lies in the ways of presenting and analyzing the content of such texts. One approach is based on the assumption that the main content of the text is determined by a set of keywords (Bag of Words) [18]. This approach does not take into account the linguistic relationships and semantics of the natural language, but allows you to quickly process the text according to formal features. Another approach is the logical-semantic processing of natural-language information based on determining the content of texts by analyzing their grammar, using knowledge bases and thesauri reflecting the semantic relationships among individual words and word groups [19]. As a result of such processing, a formalized representation of the content of a natural-language text is formed, allowing it to be analyzed by artificial intelligence methods. Due to the significant costs of maintaining knowledge bases and thesauri for each language,

subject, and document type, this approach is commonly used to solve highly specialized problems [20].

Text perception is a process and result of human mental activity, so the study of human-text interaction is considered in several directions. The first direction includes the analysis of the grammatical and semantic construction of the text, as well as the perception of the text regardless of the person. In the second direction, the features of text perception are studied in the framework of the analysis of the formal and conceptual construction of the text. The third direction focuses on individual features of text perception by a person [21]. Accordingly, the order of text perception by a person is as follows: perception of the sign form of the text, understanding the meaning of what is stated, perception of the text as an integral structure. The essence of constructing manipulations lies in the use of IPI technologies at each of the perception levels. That is, in such an organization of the text that will keep a person's attention, create the necessary emotional coloring, inspire maximum confidence in information and convince of the desired attitude to given phenomena and events.

One of the main points of identifying the manipulative impact on the target audience in a text message is the identification of text perception stages in which methods of psychological impact are applied. The methods used in the proposed text are divided into the following levels.

At the graphic level of text organization, a person's attention stops at the form, color and font. For example, by changing fonts, you can either attract the attention of the target audience or make it invisible. Text color affects the formation of certain associative links.

At the morphological level of text organization, manipulative effects are built in by adding suffixes and prefixes, thereby achieving the desired semantic coloring. For example, the use of suffixes can give neutral words an ironically disparaging meaning, or reduce their significance.

The phonetic level of organization of a text message affects the emotional perception of the text, and through it, the events and phenomena presented in the text. The essence is that a given combination of sounds for a native speaker can cause different emotions. The essence of using the phonosemantic method for implementing IPI is that combinations of certain sounds cause negative or positive emotions in a native speaker of a given language. So, for example, Russian words that are completely synonymous with "corpse" and "dead" have a totally different emotional perception. Thus, even a text that is quite neutral in content (semantics) can cause a noticeable negative (positive) attitude on the part of the target audience. At this level, the unit that forms the effect of the text on the subconscious is a sound, which is subconsciously analyzed by the human brain. For russian-language texts, such a phonosemantic method was proposed in [22], and for texts in Ukrainian, in [23]. This method can be presented as an algorithm with a mathematical description for subsequent automation.

Each sound of speech, according to the quality scale, has a certain quantitative assessment. Qualitative phonosemantic scales make it possible to assess the influence of sounds on the mental state of a person; 25 of them are distinguished [23]. To assess the impact of the sound design of a word, the general phonosemantic values of the sounds constituting the word are determined on all 25 scales.

The limited use of phonosemantic systems is due to the fact that each language must develop its own phonosemantic systems. Considering that Ukrainian and Russian are the main languages in the context of the information war with the Russian Federation, this approach is quite effectively used in the development of products of manipulative impact.

The existing software can automate the detection of the emotional content of a text by the degree of its positivity, determine the type of psycho-emotional impact, and predict the effect of the unconscious influence of texts on the reader [7]. However, the impact on the subconscious of the target audience, assessed through the phonosemantic sounding of each sound of languages, is not taken into account.

The lexical level of text organization in the text materials of IPI is presented most clearly. More often, the impact is carried out due to frequent repetition of words in order to clarify the necessary information from the desired angle, the use of words and phrases with a direct negative or positive meaning.

At the last level of text perception as a holistic structure, it is necessary to assess whether the text will be understood by the target audience. This task is solved by evaluating the message for the level of readability and accessibility of the text. Such an evaluation is carried out according to indicators borrowed from the publishing industry. These indicators include: Gunning fog index, Flesch-Kincaid index, SMOG index, Coleman-Liau index, and readability index [24]. Each of them, to one degree or another, determines the level of complexity of the text from its general perception to the level of reader's education necessary to understand the analyzed content [24]. Since analyzing a text message for the presence of manipulative content is an inverse task, the analyst eventually receives information directly about the age and education of the reader for whom the content is intended.

The SMOG index [25] shows the number of years of study required to fully understand the text. Three continuous fragments of 10 sentences are selected for determination.

$$I_{SMOG} = 1.043\sqrt{Q \times \frac{30}{S}} + 3.1291, \quad (1)$$

where Q is the number of words having three or more syllables; S is the number of sentences in the fragment.

The Coleman-Liau index (ICL) [26] was developed for computer analysis of text readability using word processors and is mostly used in specialized software for translation analysis:

$$I_{CL} = 0.0588L - 0.296S - 15.8, \quad (2)$$

where L is the average number of characters per 100 words;

S is the average number of sentences per 100 words.

The use of the first two indicators in an automated system for analyzing the text content for signs of manipulative impact presents certain difficulties, because the costs of software development taking them into account are not comparable with the effect obtained. In this case,

to assess the level of text readability, it is proposed to use the index [27]:

$$ARI = 4.71 \cdot \left(\frac{C}{W}\right) + 0.5\left(\frac{W}{S}\right) - 21.43, \quad (3)$$

where C is the number of printed characters in the text;

W is the number of words in the text;

S is the number of sentences in the text.

The feature of automating the calculation of this indicator is that there is no need to calculate the number of syllables in words.

5. Results of the development of a method for determining manipulation indicators based on morphological synthesis

5. 1. Development of a method for determining manipulation indicators based on morphological synthesis for automating message content analysis

The task of identifying signs of the use of manipulative technologies and covert propaganda in the text is difficult to formalize. However, it can be formalized by the methods of content analysis and computational linguistics [10].

Based on modern approaches of content analysis, neurolinguistic programming and automated processing of natural-language texts, the main stages of the method for determining manipulation indicators based on morphological synthesis for automating the content analysis of messages are defined:

Stage 1. Evaluation of the message at the level of perception – determining the indicator of the level of text readability.

Stage 2. Evaluation of the message at the phonetic level by the emotional impact on the reader's subconscious.

Stage 3. Evaluation of the message at the graphic level in the presence of signs of text marking.

Stage 4. Evaluation of the message for signs of using manipulation methods at the linguistic level.

Stage 1. Evaluation of the message for the level of readability and perception by readers.

Since analyzing a text message for manipulative content is an inverse task, the analyst eventually receives information directly about the age and education level of the target audience for which the content is designed.

To assess the level of text readability, it is proposed to use the index [27]:

$$ARI = 4.71 \cdot \left(\frac{C}{W}\right) + 0.5\left(\frac{W}{S}\right) - 21.43, \quad (3)$$

where C is the number of printed characters in the text;

W is the number of words in the text;

S is the number of sentences in the text.

The choice of this indicator is due to the fact that when calculating it, there is no need to additionally calculate the number of syllables in words. This will automate the process of content analysis of text messages.

Stage 2. Evaluation of the message at the phonetic level by the emotional impact on the reader's subconscious.

At this step, we consider the indicator of the emotional impact of word sounding on the subconscious of the target audience, which is targeted by the manipulative impact in the message.

It is proposed to evaluate the emotional impact through the phonosemantic sounding of each speech sound. To do this, one should use the qualitative phonosemantic scales developed in [22]. According to the value of each scale, such a text evokes emotions in the reader's subconscious. At the same time, each sound is assigned a certain quantitative value in accordance with the qualitative scale. The resulting quantitative assessment determines the general phonosemantic value of the sounds that make up the word, according to all qualitative scales. This approach requires the following steps.

Step 1. Calculation of the phonetic value of a word. At this step, you need to calculate the phonetic value of each word in the text S_t. To do this, we use the expression [28]:

$$S_t = \frac{\sum x_i k_i}{\sum k_i}, \quad (4)$$

where t is the number of the word in the text;

i is the index of the "sound letter" of the word;

x_i is the average estimate of the phonetic value of the i-th sound;

k_i is the correction factor for the i-th sound, which is generally calculated by the formula:

$$k_i = \frac{P_{\max}}{P_i}, \quad (5)$$

where P_i is the regular frequency of the i-th sound;

$P_{\max}$ is the maximum sound frequency in the word.

In this case, for the first sound letter, the correction factor is increased four times, and for the stressed letter it is doubled.

The phonetic value of the word is calculated for each of the 25 scales.

Step 2. Comparison of the phonetic value with the scale. The resulting phonetic value of each word in the text is compared with the scale of the significance zone $2.5 \geq x_{\text{sign}} \geq 3.52$. If the total phonetic value of the word S_t corresponds to the value x_{sign}, then on this scale it does not cause emotions, and accordingly, if the value takes the left or right sides of the scale of the significance zone, then it takes the value corresponding to the left or right value of the qualitative scale.

Stage 3. Evaluation of the message at the graphical level for signs of text marking.

To identify the presence or absence of marking techniques in the analyzed text, it is proposed to use the indicator of text marking intensity M:

$$M = Q/X, \quad (6)$$

where Q is the number of words in a text message with marking signs;

X is the number of words in the text.

Automation of the process of detecting this indicator can be implemented in the format of detecting a bold font in a text (bold in Microsoft Office), special emphasis, a different size font, etc.

Stage 4. Evaluation of the message for signs of using manipulation methods at the linguistic level.

The last step is the evaluation of the message for the presence of manipulation techniques and methods of psychological impact. Since such techniques are quite different in their properties, this stage requires the implementation of certain steps.

Step 1. Evaluation of the sensationalism indicator. One of the manipulation techniques taken from the neurolinguistic programming technology is the presentation of an event as a sensation. This approach aims to draw the attention of the target audience to the message. So, the assessment of message sensationalism is a fairly informative parameter for identifying signs of manipulative impact in the message text. Quantitatively, this indicator is proposed to be presented as an integral indicator:

$$S = \frac{A_S + U_S + N_S + L_S}{4}, \quad (7)$$

where A_s is the level of attention;

U_s is the level of surprise;

N_s is the level of strengthening the text significance;

L_s is the level of appeal to the leader.

Methods for calculating partial indicators are given in Table 1.

Step 2. Emotional saturation of the message. Considering the main goal of implementing IPI as inciting the target audience to action, it is clear that the best way to achieve this goal is to create such content that primarily affects primitive human reactions, that is, forces the reader to be guided by emotions in his actions. When analyzing content, it is necessary to take into account the emotional saturation of the message. This text characteristic can be expressed by an integral indicator:

$$E = \frac{J_E + S_E + C_E + B_E + P_E + Ac_E}{6}, \quad (8)$$

where J_E – level of expression of object features;

S_E – level of lexical comparisons;

C_E – level of exclamations;

B_E – level of action designation;

P_E – level of presupposition;

Ac_E – level of emphasis.

The partial indicators collected in (8) and the method of their calculation are given in Table 2.

Step 3. Determining the availability of methods of information and psychological impact in the message. To determine the methods of psychological impact in the text used in the formation of a message, we use the techniques of qualitative content analysis in combination with text filtering mechanisms to detect keywords on certain topics. Given the need to further automate the calculation processes, it is important to specify the methods used in the formation of manipulative text content. The analysis of existing methods of psychological impact made it possible to select those whose features can be identified using the appropriate databases of marker words. So, such methods include: "labeling", "simplification", "accessible explanation", "citation and recommendations", "statistics", as well as the method of appeal – "legitimacy" [7]. The method is identified based on the indicators summarized in Table 3.

The degree of message reasonableness *Ri* is another indicator that can be analyzed to obtain data on the method of manipulative impact embedded in the text content. An integral indicator for calculating the degree of message reasonableness is proposed to be presented as follows:

$$Ri = \frac{Ri_{An} + Ri_{Op}}{2}, \quad (9)$$

where Ri_{An} is the level of reference to an anonymous source;

Ri_{Op} is the level of authorization of the opinion.

The proposed integral indicator consists of partial indicators, the characteristics and structuring mechanisms of which are presented in Table 4.

By the first partial indicator, we mean such a manipulative method of speech selection of information as the use of unauthorized information, which contradicts the rules of journalistic ethics. This technique refers the reader to some anonymous source, which does not allow the target audience to be critical of the statements, by creating an illusion of reliable information.

By the level of reasonableness of the author of an opinion, we mean a partial indicator that characterizes a reference either to the opinion of a person with a high level of authority, or to the author's thoughts. At the same time, the manipulative nature of the technology is based on the psychological tendency of a person to rely on the judgments of a specialist. Comments of an authoritative person affect the non-critical perception of information and contribute to changing the recipient's attitude towards it.

Table 1

Partial indicators of message sensationalism

Indicator	Characteristic	Structuring mechanism
A_s	the presence of words in the message that always attract attention, increase anxiety	text filtering mechanism for keyword detection
U_s	the presence of words in the message that create a sense of surprise of the event	text filtering mechanism for keyword detection
N_s	the presence of intensifier words in the message	text filtering mechanism for keyword detection
L_s	the presence of lexical constructs in the message text with the involvement of the leader	text filtering mechanism for phrase detection

Table 2

Partial indicators of emotional saturation of the message

Indicator	Characteristic	Structuring mechanism
J_E	the presence of adjectives in the message text	the mechanism of morphological analysis, which aims to identify the relative number of adjectives in the message
S_E	the presence of adverbs, comparisons in the message text	text filtering mechanism to identify adverbs that direct the listener's attention to inner feelings
C_E	the presence of exclamation words in the message text	text filtering mechanism for keyword detection
B_E	the presence of verbs in the text indicating mental and temporal action	text filtering mechanism for keyword detection
P_E	the presence of words in the message text indicating the use of presupposition	text filtering mechanism for keyword detection
Ac_E	the presence of markers in the text	using methods of morphological analysis of the text to determine the proximity of adverbs and adjectives in the text. Finding the facts of their deliberate doubling for emphasizing purposes. The mechanism of text filtering is applied to detect: exclamation marks, question marks, highlighting words with capital letters, spaces

Table 3

Morphological table of methods (techniques) of psychological impact

Indicator	Characteristic	Structuring mechanism
RPSY – level of stamping	the presence of neologisms in the text indicating the use of the IPI method "Labeling"	the text filtering mechanism is used to identify keywords that make up the database formed by analysts on a particular topic
UnPSY – level of ambiguity of statements	the presence of words in the text indicating the use of the IPI method "Simplification"	the text filtering mechanism is used to identify keywords
AuPSY – level of reference to the opinion of authorities	the presence of words in the text indicating the use of the method of appeal "Legitimacy"	the text filtering mechanism is used to identify keywords
AlPSY – level of reference to public opinion	the presence of words in the text indicating the use of the IPI method "Accessible explanation"	the text filtering mechanism is used to identify keywords
AiPSY – level of reference to other sources	the presence of words in the text indicating the use of the IPI method "Citation and recommendation"	the text filtering mechanism is used to identify keywords
AnPSY – level of digital saturation	the presence of figures in the text indicating the use of the IPI method "Statistics"	the text filtering mechanism is used to detect character strings containing figures

Table 4

Partial indicators of reasonableness of statements

Indicator	Characteristic	Structuring mechanism
RiAn	the presence of words in the text indicating the unreliability of the source	the text filtering mechanism is used to identify keywords
RiOp	the presence of words in the text indicating the degree of reasonableness and authorship of the opinion	the text filtering mechanism is used to identify keywords

Thus, the proposed method for determining manipulation indicators based on morphological synthesis for automating the content analysis of messages allows considering all levels of the target audience's perception of the message designed to influence them. The proposed indicators were summarized and described in a formalized form. This approach allows them to be used for developing specialized software for the automated detection of IPI signs in text messages distributed in social Internet services.

Graphically, the method for determining manipulation indicators based on morphological synthesis for automating the content analysis of messages is shown in Fig. 3.

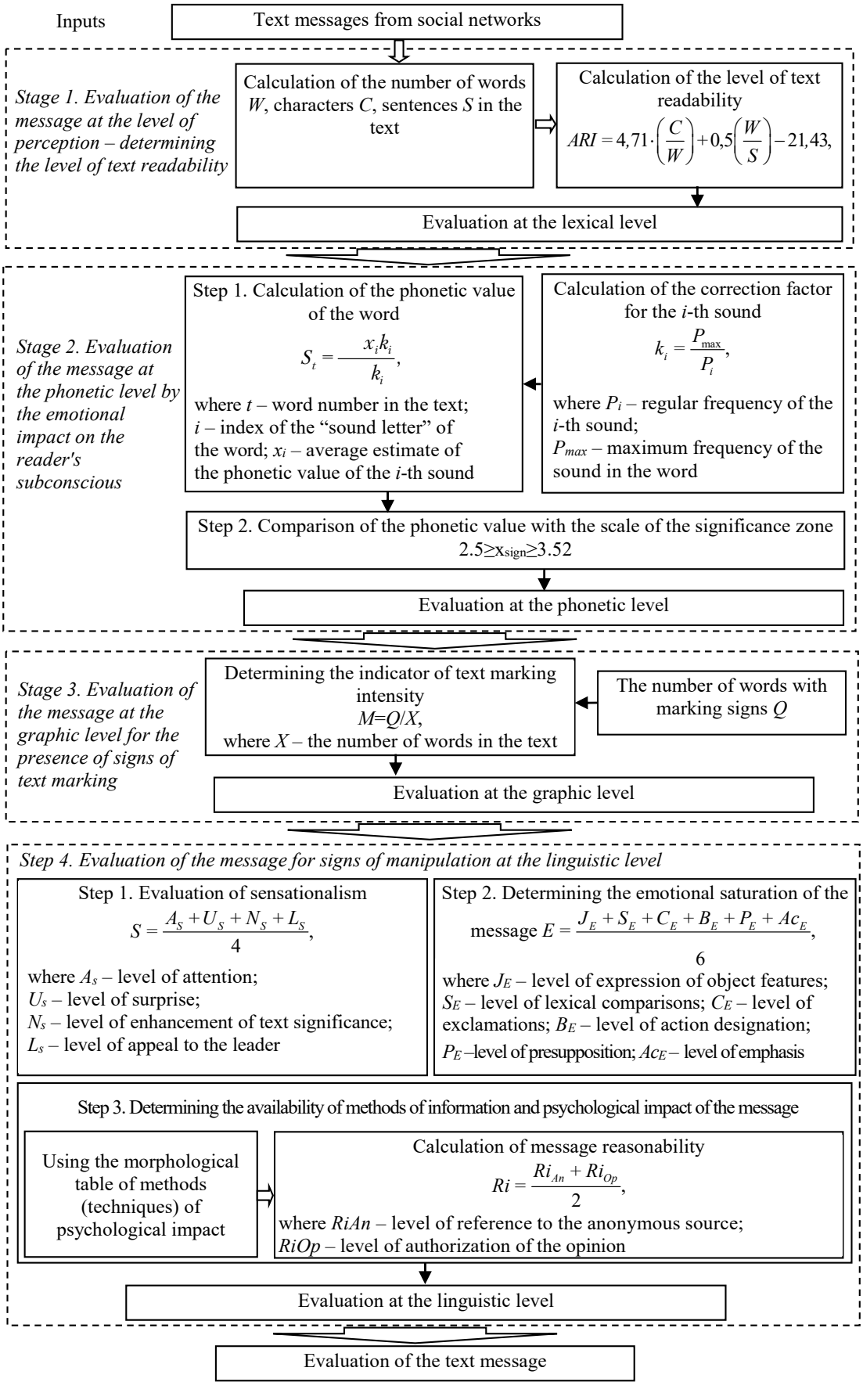

Fig. 3. Method for determining manipulation indicators based on morphological synthesis for automating the content analysis of messages

5. 2. Modeling the developed method for determining manipulation indicators and testing its effectiveness

To verify each stage of the developed method for determining manipulation indicators based on morphological synthesis, consider an example of a real message on the social network Facebook (Fig. 4) (https://www.facebook.com/vasylart).

Suppose that the purpose of publishing this message is the psychological impact on a certain target audience. In practice, the proposed method was implemented in the form of a specialized software product, the results of the software operation according to each stage of the method are presented.

Stage 1. Evaluation of the message for the level of readability and perception by readers.

The ARI readability index of the message is calculated by expression (3):

$$ARI = 6.26 \times \frac{233}{43} + 0.2805 \times \frac{43}{5} - 31.04 = 5.2. \quad (10)$$

The resulting value belongs to a low-readability interval, that is, the text is very simple and understandable. Since the text is designed for a lower level of education than the target audience has, this corresponds to the level of target audience education set by the developer of the message by 78 %. The value that exactly corresponds to the given education level of the reader is taken as 100 %. The result obtained was verified using specialized software based on the proposed method (Fig. 5).

Stage 2. Evaluation of the message at the phonetic level by the emotional impact on the reader's subconscious.

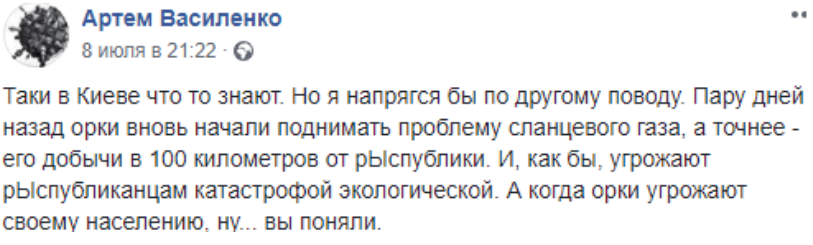

Fig. 4. Message (Russian-language text) from the Facebook page

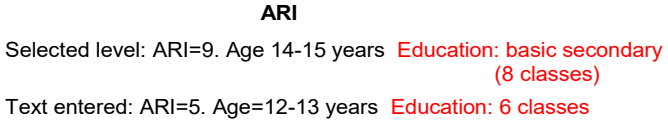

Fig. 5. Results of ARI index calculation using specialized software

Step 1. Calculation of the phonosemantic coloring of a word. The calculation of the phonosemantic coloring of the text by experts is given on the example of one of the 25 scales of phonosemantic coloring [22], namely, Masculine-Feminine, and on the example of one word from the above message (Table 5).

Step 2. The obtained result S_t=2.38 is compared with the scale of the significance zone $2.5 \geq x_{sign} \geq 3.5$, which indicates the presence of the emotional coloring "Masculine" in this word, bearing 21 % of this emotion. Fig. 6 shows the corresponding result of the calculation using specialized software.

Blue in Fig. 6 reflects the saturation of negative emotional coloring, and red – positive, in accordance with each scale of phonosemantic value. Each scale has a maximum value of 100 %. The percentage of emotional coloring of a particular text message corresponds to an estimate of the power of the emotional component of the text message.

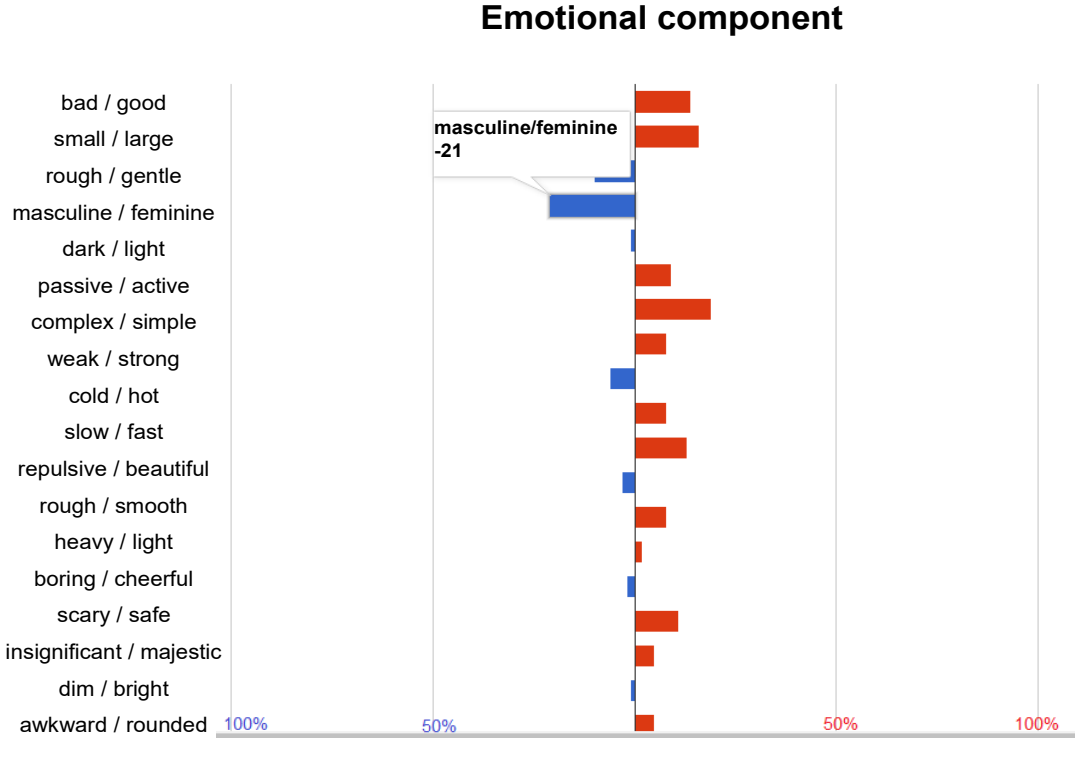

Fig. 6. The result of evaluating the emotional coloring of the text message using specialized software

Table 5

Calculation of phonosemantic coloring of the word "орки" (orcs)

Word	Inputs		k_i	$x_i k_i$
	x_i	P_i		
о	3.7	0.067	4*1.00=4.00	14.8
р	4.7	0.024	2.79	13.11
к	2.5	0.003	22.33	55.825
и	1.9	0.041	1.63	3.097
Σ=			30.75	86.832
S_t=2.38				

For example, Fig. 6 shows an information window, which indicates that the word analyzed on the scale of emotions "Masculine-Feminine" is colored by the masculine emotion by 21 %.

Stage 3. Evaluation of the message at the graphic level for the presence of signs of text marking.

The presence of text marking techniques is determined by formula (6). In this text, there is one technique (large font) applied in two words, i.e. Q={*рЫспублики*, *рЫспубликанцы*}, where $Q \epsilon B$`, according to expression (6) $M = \frac{2}{43} \approx 0.05$, which corresponds to the results of program execution (Fig. 7).

Stage 4. Evaluation of the message for signs of using manipulation methods at the linguistic level.

MARKING

Text marking intensity M=0.05

Q={*рЫспублики*, *рЫспубликанцы*}

Fig. 7. Results of calculating text marking intensity using specialized software

At this stage, we consider an example of analyzing another message, which, unlike the previous one, uses methods of psychological impact. Checking the performance of indicators for determining methods (techniques) of psychological impact was carried out using the developed specialized software, which automatically allows you to conduct content analysis of the text. At the same time, text filtering mechanisms were used to detect keywords. Keywords corresponding to certain methods of psychological impact are additionally highlighted with color, which allows the analyst to focus on certain sentences to make the right decision. Examples of analyzing text messages with signs of IPI are shown in Fig. 8.

Each of the proposed features of the method of psychological impact based on the proposed method is displayed in the right column of the main window of the developed software. The presence of the corresponding method of psychological impact in the text is confirmed by the presence of words corresponding to a particular method. Such words are contained in a pre-created database and serve as corresponding indicators (shown in green when the text is highlighted). Thus, automation of this method allows the operator to quickly determine the presence of methods of psychological impact in the message text.

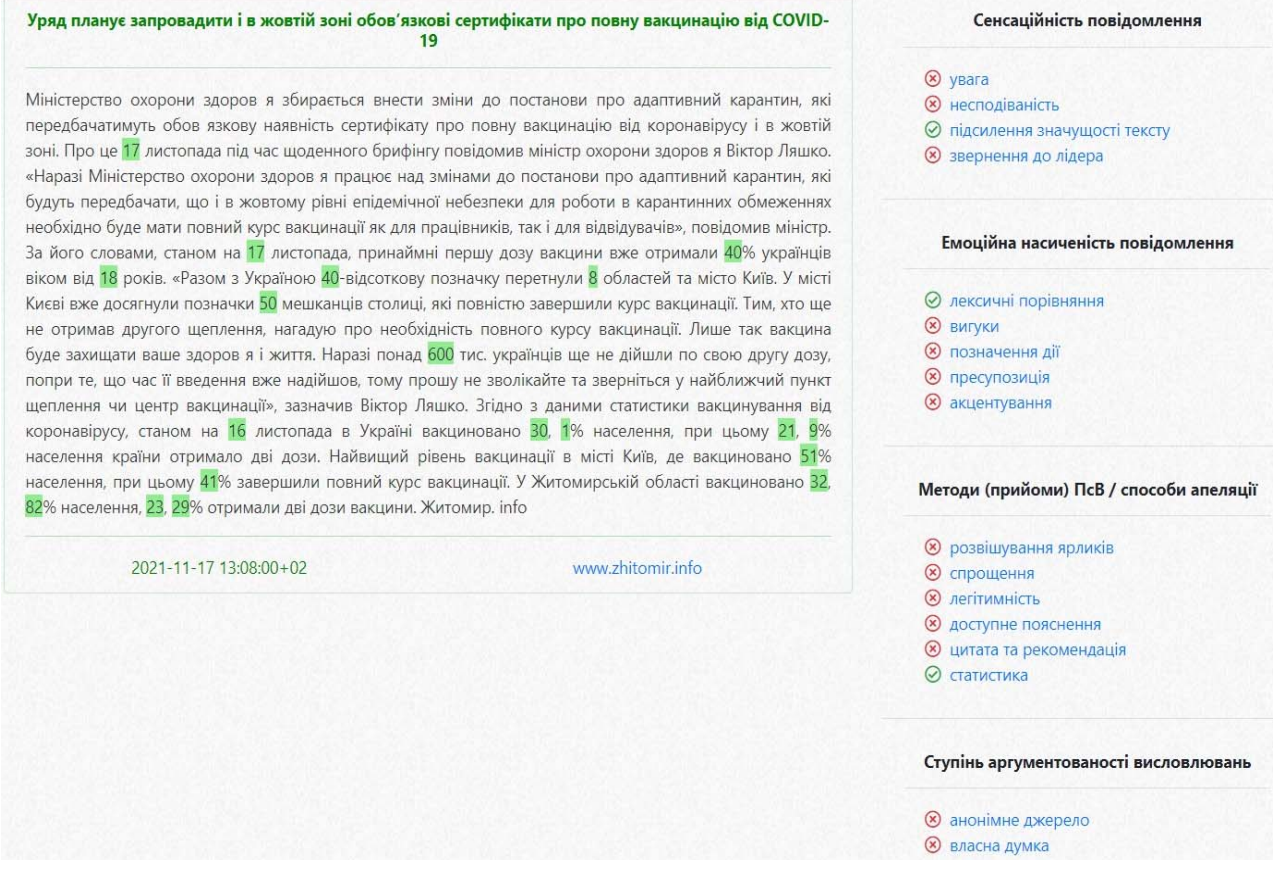

Fig. 8. An example of a text message (Ukrainian language) content analysis software window containing methods of psychological impact

To compare the effectiveness of the developed and the known method of message analysis (expert evaluation), a test sample of text messages, pre-assessed by certain indicators, was determined. The essence of the known Delphi method for message analysis (expert evaluation) is the intuitive-logical analysis of text messages by specialists with a quantitative assessment of judgments and formal conclusion. Although the Delphi method produces conclusions based primarily on rational data and not on the emotions of experts, it takes a long time when used in practice [12].

The results of the experimental evaluation of the effectiveness of the developed method for determining manipulation indicators based on morphological synthesis for automating the content analysis of messages are shown in Fig. 9.

Table 6 shows the results of evaluating text messages with signs of manipulative impact by the known expert evaluation method and the developed method. 10 operators performed an expert evaluation on a sample of 100 text messages.

Table 6

Results of evaluation of text messages with signs of manipulative impact

Expert evaluation method												Evaluation accuracy, $T_{ev.}$
Operator		1	2	3	4	5	6	7	8	9	10	
mark	contains signs	65	67	69	61	72	67	70	64	67	70	71 %
	contains no signs	35	33	31	39	28	33	30	36	33	30	
Developed method												Estimation accuracy, T_{ev}
Operator		1	2	3	4	5	6	7	8	9	10	
mark	contains signs	55	61	60	61	62	63	59	61	63	61	84 %
	contains no signs	45	39	40	39	38	37	41	39	37	39	
Preliminary evaluation data												Gain
mark	contains signs	53										13 %
	contains no signs	47										

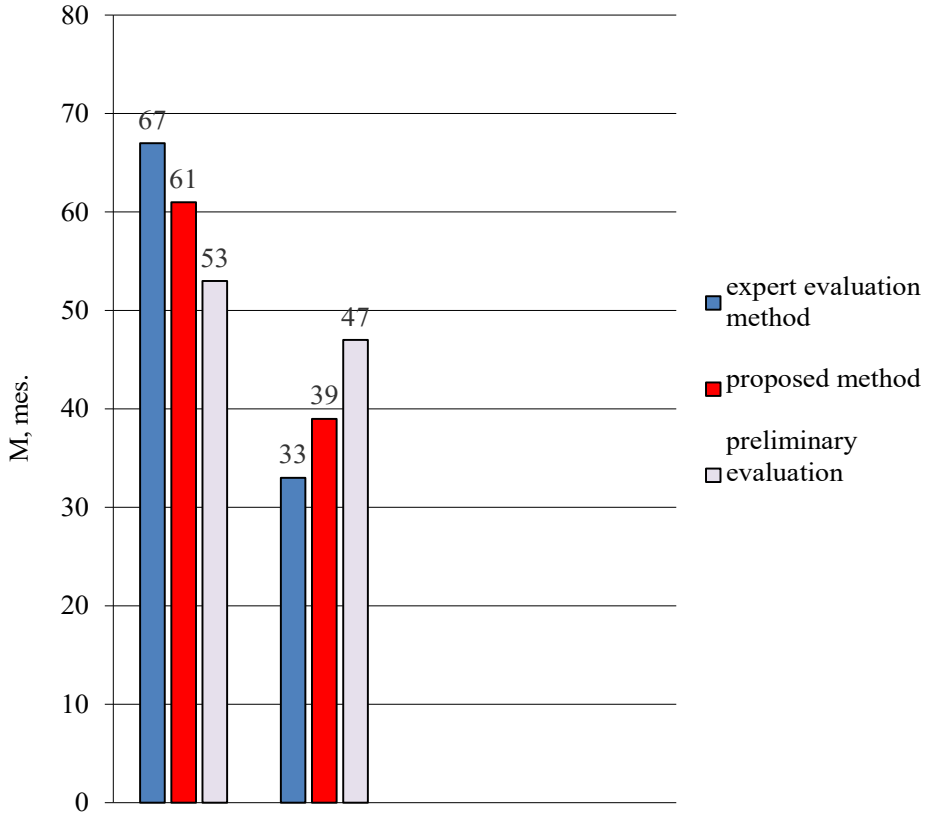

Fig. 9. Diagram of the results of the evaluation experiment of the proposed method

Thus, according to the results of the field experiment, it was found that on average, from the test sample of text messages provided for the experiment by the expert method, the probability of accurate assessment is 0.71, and when using the developed method – 0.84. That is, by automating the evaluation of a text message by reasonable criteria, the developed method made it possible to increase the accuracy of evaluating messages for manipulative impact by 13 %, which reduced the influence of the subjective factor on the evaluation result.

6. Discussion of the results of research on the method for determining manipulation indicators based on morphological synthesis

The main feature of the developed method of determining manipulation indicators based on morphological synthesis to automate the content analysis of messages is its complex nature, including four stages:

– evaluation of the message for the level of readability and perception by readers;

– evaluation of the message at the phonetic level by the emotional impact on the reader's subconscious;

– evaluation of the message at the graphic level for the presence of signs of text marking;

– evaluation of the message for the presence of signs of using manipulation methods at the linguistic level.

It is the complex nature of the developed method that gives a synergistic effect, which makes it possible to increase the accuracy of message evaluation compared to known methods [10, 14]. Unlike the method described in [10], the developed method takes into account aspects related to the identification of methods of psychological impact in messages. The method proposed in [14] for identifying signs of information impacts in social Internet services by content features does not have a description of indicators of the presence of manipulation methods. This drawback was eliminated in the proposed method by introducing partial indicators given in Table 1.

An analysis of the results of experimental testing of methods for evaluating text messages for signs of manipulative impact showed a significant increase in the accuracy of message evaluation by the developed method compared to the known method of expert evaluations. Experts' conclusions about the presence of a manipulative component and signs of IPI in the text of messages confirm the conclusions of the calculations based on the proposed formalized indicators in an automated mode.

A partial limitation of the developed method is that when evaluating the emotional coloring of a text message at the second stage of the method using specialized software, the target audience is considered homogeneous in its composition. That is, the psychological features of the perception of text messages by men and women, demographic characteristics (average age, place of residence, nationality) and other features of the target audience that may affect the result of evaluating the emotional coloring of a text message are not taken into account.

A general limitation of the developed method is that text messages of up to 150 words are selected for the evaluation, since in large text messages several text parts of different coloring levels can be used both at the phonetic, and graphic and linguistic levels, which reduces the accuracy of the proposed method.

The disadvantage of the developed method is the simplification of the first stage, namely, determining the level of readability and perception of text messages based on the calculation of the ARI index, which has limited accuracy. This choice of method for evaluating a text message for readability is primarily due to the ease of automation, since the index determined by the number of letters in words can be quickly and accurately calculated using computer programs.

One of the promising directions for the further development of the method is the improvement of specialized software for automating the detection of signs of IPI in text messages, namely, the development of a more friendly, intuitive interface. This will simplify the training of personnel using the specified specialized software and reduce the time spent working with text messages to assess the presence of manipulative impact.

The proposed method can be used in countering information and psychological impact at the stage of analyzing propaganda messages distributed on the Internet and developing your own text messages.

7. Conclusions

1. A method for determining the indicators of manipulation in text messages based on morphological synthesis has been developed.

To analyze the text for signs of manipulation and methods of psychological impact, a system of indicators in a formalized form is proposed. The described formalized indicators allow using them in the development of specialized software for the automated detection of IPI signs in text messages distributed in social Internet services.

The developed method makes it possible to reduce subjective errors of personnel in determining manipulation indicators and increase the accuracy of evaluating messages for manipulative impact by 13 %.

2. Modeling of the developed method for determining manipulation indicators based on morphological synthesis was carried out and its effectiveness was tested.

According to the results of the experiment, it was found that the accuracy of evaluating messages for manipulative impact by reasonable criteria of the developed method is 13 % higher than that of the known expert evaluation method. It was determined that automation increases the efficiency of text message processing and reduces the subjective error of experts when performing content analysis of text messages. The use of the developed software made it possible to reduce the time for processing text messages by 20–25 % compared to the evaluation of text messages by the same system of indicators by experts.

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