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Graphic model of the target audience of psychological influence in social networks

An approach to one of the important stages of psychological operations is described - the study of the target audience. The formalized description of the target audience is reduced to the construction of a graph model of the target audience. The developed graph model allows to take into account the structure of the target audience and determine individual structural elements. The stages of graph model construction are described and the algorithm for constructing the target audience in social networks is presented. The results of modeling after the implementation of the above algorithm are presented.

The rapid development of methods and means of psychological impact (PI) is associated with the growing role of social Internet services. For example, the experience of the antiterrorist operation (ATO) in the Donetsk and Luhansk oblasts showed that for the effective dissemination of psycho-social influence (PSI) in social networks (SN) it is necessary to analyse the structure and characteristics of the target audience (TA) behavior in the SN. The study of the course of hybrid conflicts in the eastern Ukraine makes it possible to distinguish two TAs onto which the psychological influences should focus in the interests of organizing effective counteraction to the destructive propaganda of the aggressor. These are military personnel directly involved in hostilities and the local population of those areas where hostilities are taking place. For the local population, for example, the object of the study are the actors (nodes) and the associations that characterize the relationships between them (friendship, communication, common interests). Thus, in the broadest sense, a TA is understood as a social group, united in a network, that is, a plurality of subjects and the relations between them.

Formally, TA from the local population in the combat zone can be submitted as a graph G (N, E), in which N = {1, 2, ..., n} is the set of nodes (actors) and E = {1, 2, ..., k} is the set of edges that represent the relation between actors. Under the link between actors we understand the social ties that arise between members of the TA. Constructing such a representation of the TA actors, we obtain an informational model of the considered social group in the form of a graph. The first step in the analysis of social groups is the construction of a contextual background. It should include information about the actors and the links between them. To obtain this information, it is now convenient to use social Internet services that provide access to relational data of actors, in particular in SNs. As a source of information about actors, it is advisable to choose the most popular SNs. The following limits apply to constructing the model: the target audience belongs to a group of actors who represent specific population and age groups, i.e. more than 18 years-olds; selection of settlements and collection of relational data for analysis is carried out by experts or units of psychological operations (PSYOP) in accordance with the current military-political situation; information for constructing the TA

model is collected only with the SN, which is most used by the TA from the local population.

The algorithm for constructing a TA model based on a graph consists in the successive execution of a number of steps described below.

Stage 1. Selection of TA actors from the entire set of SN actors. Among all actors, only those that match the characteristics of the TA are chosen as the age and place of residence (in accordance with the accepted restrictions)

Stage 2. Construction of an information field for characteristics of TA actors. A set of relational data for constructing a social graph should include data that can be obtained from the most used SNs, such as VKontakte, Fasebook, and Twiter. To determine social connections, we use the connections indicated by sociologist Mark Granovetter.

Stage 3. Formation of the link table. The sign of the presence of an edge between the i-th and j-th actors in SN is determined by the formula:

$$\text{Link}_{ij}=\begin{cases}1, & \text{if one would have one communication characteristic available to the actor}\\ 0, & \text{if the characteristics of the connection are absent in both actors}\end{cases} \quad (1)$$

Stage 4. Construction of the graph. On the basis of the data obtained in the second stage of the process, the graph G (N, E) is constructed.

Stage 5. Determination of the weights of the edges of the graph. The weight of the edge of the graph corresponds to the strength of the social ties that exist between members of the social group. In the context of social networks, this means the intensity of the relationship between actors in social networks, a combination of emotional, friendly, working relationships that arise in social networks. Each of the characteristics of the relationship of actors can take values [0, 1].

Stage 6. Determination of the weights of the vertices of the graph. It is not known in advance what role SN plays for the actor. Weights of nodes are proposed to be formed by calculating the authority of each node. This will ensure the hierarchy of TA actors. The authority in the social graph can be analyzed using the PageRank criterion that uses Google's search system.

Stage 7. Formalization of the graph model. Let's formalize the graph model and present it with a mathematical model, a matrix of adjacency. The adjacency matrix $S = \{a_{mn}\}$ in SNA is a square matrix with the number of rows and columns corresponding to the number of nodes. The diagonal of the matrix characterizes the node itself, therefore, the diagonal elements correspond to the weights of the vertices of the graph. If the actor has a connection with another actor, then the weight of this connection is written to the matrix at the intersection of the associated actors. If the actors do not have connection to the matrix write 0.

$$S=\begin{pmatrix} a_{11} & \cdots & a_{1n} \\ \vdots & \ddots a_{ij} & \vdots \\ a_{m1} & \cdots & a_{mn} \end{pmatrix} \quad (2)$$

where a_{ij} is the weight coefficient of the edge, which binds the ith first and jth actors, the elements of the matrix, where $i = j$, correspond to the weighted coefficients of the nodes, respectively, and n is the number of nodes.

Stage 8. Definition of the hierarchy in the graph model TA. Using a weighted graph allows to take into account the hierarchy of actors in the network. Since the links between the actors are not directed, the transition to the oriented graph is impossible. From the initial graph, we pass to its root structure with the root in the node that has the greatest weight. Exploring the characteristics of actors at each level of the hierarchy allows to allocate the most influential of them at each of the levels.

Algorithmization of the above-mentioned stages allows us to submit a block diagram of constructing a graph model TA (Figure 1).

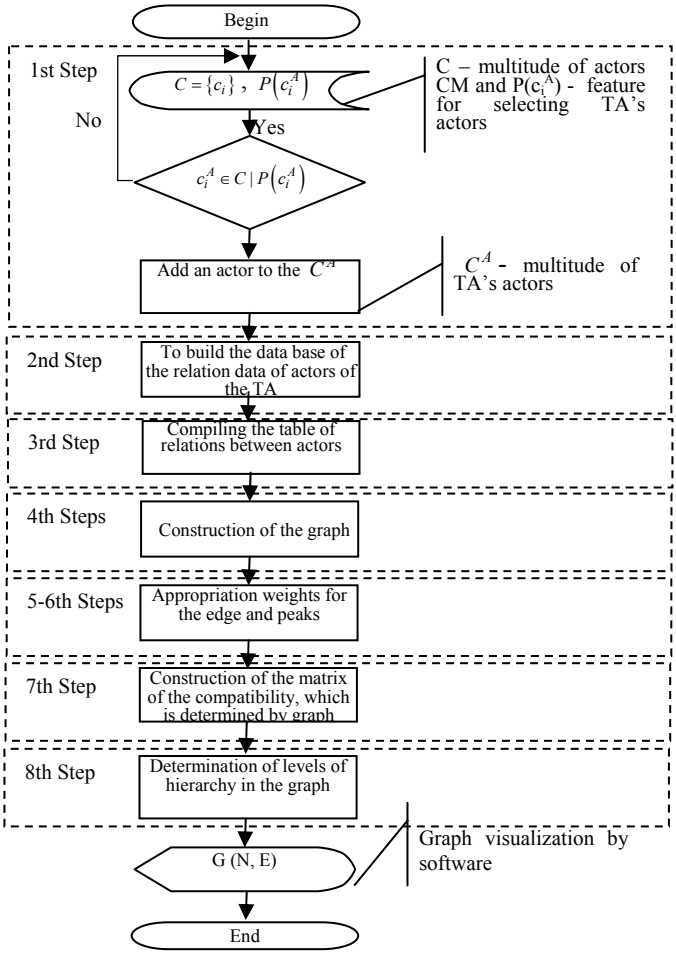

Figure 1: Block diagram of the algorithm for constructing a graph model TA in SN.

The proposed approach to the construction of the graph model of TA to the modeling of social groups and social processes, in contrast to other models, allows to take into account the structure of the TA, which in the future will allow the identification of opinion leaders, information dissemination mediators, and to predict new relationships that may arise between actors. Such a model allows modeling the processes of information dissemination taking into account all existing channels (social relations) for the dissemination of information. Unlike existing graphic models describing terrorist groups, the model does not require preliminary intelligence for group leaders and does not rely on expert estimates that can require large amounts of time on a large scale, since the weight of the actor computes the algorithm. Some of their social connections are selected as links between subjects that accurately define communication chains, as opposed to hyperlinks and comments. The mathematical basis of the model is flexible and can be applied to any TA.

The result of constructing a graph model of the target audience in accordance with the proposed algorithm is shown in Fig. 2

A graph model is constructed by means of modeling graphs of Gephi, where the diameter of the vertex corresponds to the weight of the vertex, and the thickness of the line corresponds to the weight of the ties between the vertices.

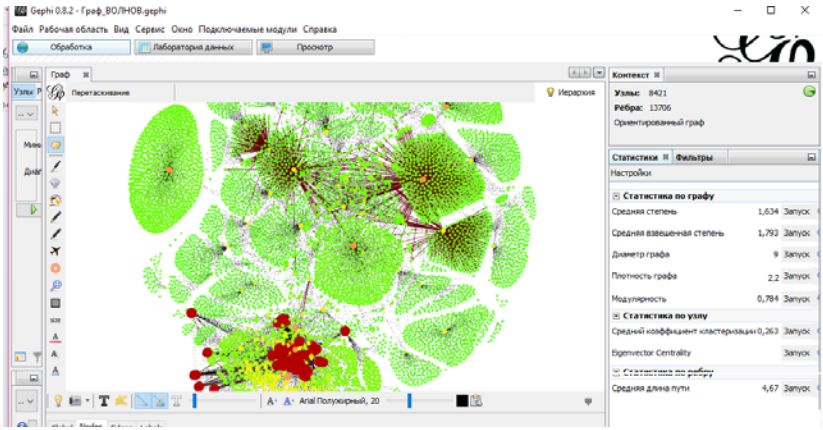

Figure 2: Window of the program execution: the construction of the graph model of the target audience (7500 actors, the city of Volnovaha, Ukraine)

The proposed approach to constructing a graph model of TP for modeling social groups and social processes, unlike other models, allows to take into account the structure of TP, which will further enable the identification of opinion leaders, mediators for the dissemination of information and the prediction of new relationships that may arise between actors. The graph model allows you to model the processes of disseminating information, taking into account all existing channels (social relations) for disseminating information. Unlike existing graph models, for

example models of terrorist groups analysis, the model does not require prior information about the leader of the group and is not based on expert assessments that may require a large number of large-scale audiences, since the model allows you to calculate the actor's weight by algorithm. Social connections, chosen as links between actors, precisely determine communicative chains, other than hyperlinks and comments. The mathematical basis of the model is flexible and can be applied to any TA.

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