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ВИКОРИСТАННЯ МЕТОДУ ЗРОСТАЮЧИХ ПІРАМІДАЛЬНИХ МЕРЕЖ ТА СИСТЕМНОГО АНАЛІЗУ В ФОРМАЛІЗАЦІЇ МОДЕЛІ КОРИСТУВАЧА ІНФОРМАЦІЙНИХ МЕРЕЖ

Розроблюється модель користувача Інформаційних мереж як поганоформалізованого об'єкта. Розглянуті та проаналізовані методи кластерного аналізу та зростаючих пірамідальних мереж. Запропоновано використання методів системного аналізу для побудови формалізованої моделі та структури спільноти користувачів Інформаційних мереж відносно їх характеристик та отриманих в опитувані даних.

Ключові слова: *інформаційні мережі, користувач, поганоформалізовані об'єкти, системний аналіз, зростаючі пірамідальні мережі.*

1. Introduction

The problem of formalization of Information Networks (IN) is the one of the most relevant and topical in the world of telecommunication technologies, but its modern solution cannot be represented through analytical calculations and forecasting, as it once has been previously, and should be based on modeling [1, 2]. Thus it could be argued that the development of IN user model is one of the components in the process of IN formalization and a task that can be solved by methods of system analysis and simulation. It is assigned the task to develop the choice of scenario analysis system that will solve the problem of constructing an IN user model as fuzzy formalized object.

This is explained an urgency of these researches.

2. Analysis of information sources and problem statement

Formulated aim is settled in improvement of the efficiency and reliability in IN modeling by formalizing one of the most important input parameters of user model of the Information network. But a lack of formalized description of the main IN figure (user) remains open.

Users are the sources of information and consumers who use IN services and create a flow of messages of different type and purpose. It put users forward to the requirements for delivery and processing in compliance with certain qualitative and quantitative indicators.

The complexity of the object, which is IN user, determines its versatility, implicit relationship and the relationship of its characteristics, as well as the difficulty of these parameters formalizing. However, the precise method of analysis for the research and developing of fuzzy formalized objects domain has not yet been proposed [3–6], so the development of IN user model will be provided in heuristic way. Conceptualizations that underlies in mathematical modeling are emerged from the analysis of logic and along with that the analysis of the main axiomatic systems are similar to systems located at the base geometry. These researches certify benefits received in formulating axioms expedient to some well-defined mathematical way. There may be found attempts to develop mathematical models as systems of linear differential equations, or in the form of linear operators in Hilbert space. They can offer a mathematical model that gives an idea of how the system works in integrity. This model in the case of being successful is apparent structure, and not strictly a structure model, ignoring something in the structure of super-system.

3. Object, goal and research issues

Object of research is User of Information Networks.

The goals which are set in the article defined as the creation of IN user model, and which are focused on the seventh level of OSI model and external IN environment.

To solve this problem it is necessary to do the following.

1. State the main characteristics of the design principles of formalized user model.

1.1. Analyze methods of system synthesis of complex objects, fuzzy formalized object classification and choose the ones that will be best to identify the inner relationship and the relationship of internal model parameters.

1.2. Develop a formalized model of IN user, considering relationships that identified in the preceding paragraph.

2. State the main characteristics of network information (NI) from view of user and the parameters that affect the user.

2.1. Analyze existing sources to determine the characteristics of IN, which is closely associated with the user and IN parameters that are set by users.

2.2. Develop a combined model, where the user model and IN are closely related. This model will demonstrate impact on IN user, thus resolving the issues, rose in the task.

In terms of IN optimization and synthesis, this problem is a major one, because the user is a central object of IN.

4. Research result of formalization of User Model of Information Network using methods of system analysis and growing pyramidal networks

One of the goals of the IN user formalization is a need to carry out an asymptotic analysis as approximation of a complex object into more simple one to define a set of parameters that affect the behavior of the user directly, discarding minor and interdependent. In the light of the dual structure of fuzzy formalized object researcher must consider two interacting environments: external and internal.

There were proposed a number of characteristics of the IN user including standard social information (age, sex, education, occupation), extending the internal environment for the project, and the specific characteristics (mobility, stationarity, learning, interest in innovations, risk, etc.) protruding outside environment through which a user can uniquely characterize IN as an object, acting on the construction and development of IN.

The sociological research (through questionnaires) among a random group of IN users was conducted in order to prove the feasibility and adequacy of the model to the current realities and conformity assessment produced by the model of modern behavior of real IN users. As result of this research is collecting the sample of data that have been processed and described the proposed number of characteristics.

The next step was to determine the formation of user groups on the proposed specifications. This is done using the methods of cluster analysis, using various methods of association (the method of single linkage, complete linkage, average unweighted pair, pair-wise weighted average, median, and Ward) and various measures of distance (Euclidian metric, Euclidian square metric, Chebyshev metric, Manhatten metric). Fig. 1–3 shows the results of cluster analysis of researched data sample.

The results obtained by clustering shows the most common combinations of features (mobility and field of activity, age and occupation, risk and quality requirements for services, and others). Combinations of these characteristics can be interpreted as a key set for IN users that is the most frequent references to the same values in the same combination of characteristics are typical for the class names of those or other IP users.

The next step in goal-setting and problem analysis is describing the interrelations of criteria that are not correlated. The move is meant by a formalization of the investigated object and its representation as a set of parameters and the set of conditions that will fully characterize the object and its relations with super-system. As a result of work done in [7–9] is described in this expression:

$$U = \overbrace{\{(M,Ar)(A,F)(Uq,R)(O,P)(Sx,E),S,Us,..\}}^{K\geq 0{,}99997,\ C(is)<C(isb)\leq C(ins)}, \qquad (1)$$

A — age, Sx — sex, E — education, Ar — activity area, F — functional activity, S — stationatiry, R — riskness, M — mobility, O — learning, P — interest in innovations, Uq — special need in services quality, K — factor of service accessibility, $C(is)$ — cost of information-communicational service, $C(isb)$ — cost of improved information-communicational service, $C(ins)$ — cost of information service.

The next step is carried to determine the structure of the object. Different methods of fuzzy objects formalization were used and described in [7–9]. One of results is the formation of conceptual model structure of IN user, based on the method of growing pyramidal networks which involves consideration of the user as a set of parameters to specific values and dynamically formed by splitting the group into classes of users. The last, in turn, lead to the formation of a systematic set of input parameters, and the development of qualitative and quantitative requirements to super-system (IN), and the subsequent introduction of IN user model in general. It reflects the nature of systems analysis, which must be applied to the IN user model and IN formation model that has different properties: attribute, relational.

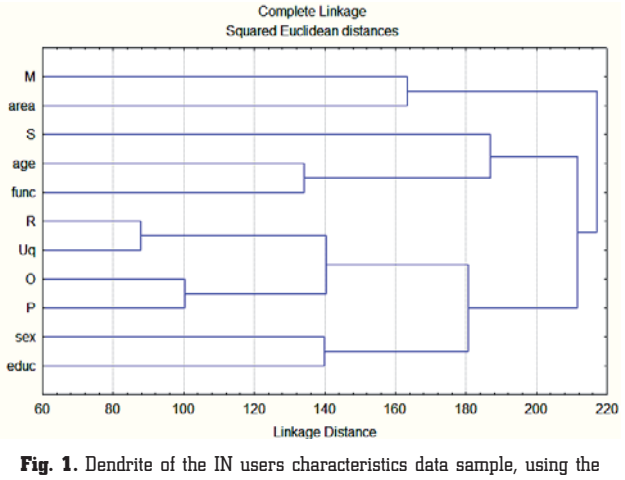

Fig. 1. Dendrite of the IN users characteristics data sample, using the method of full communication and squared Euclidean metric

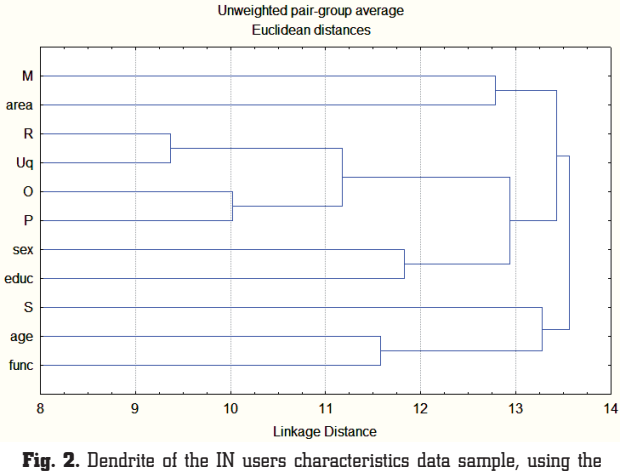

Fig. 2. Dendrite of the IN users characteristics data sample, using the method of Unweighted pair-group average and Euclidean metric

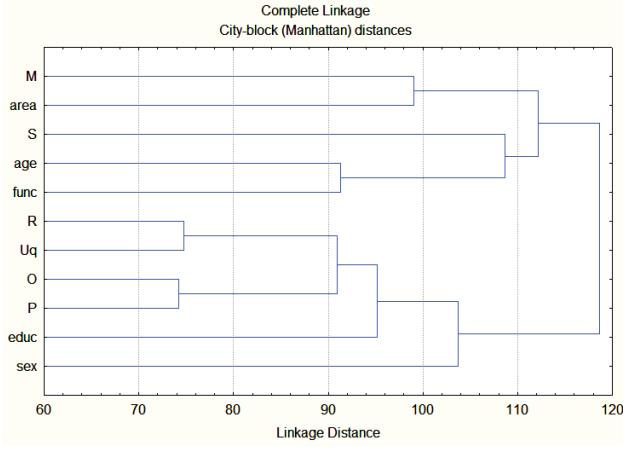

Fig. 3. Dendrite of the IN users characteristics data sample, using the method of Complete linkage and City-block (Manhattan) metric

The results of the growing pyramidal networks method [10, 11] have all these properties, the formation of concepts is based on objects that have the same degree of certainty and an equal number of input parameters, structuring concepts derived from heterogeneous data.

Class I = {Sx(m), Ar(engineer sphere), E(0,6..0,79), M(0..0,19), S(0,4..0,59), P(0,4..0,59), O(0,8..1)}

Class II = {Sx(m), Ar(service sphere), E(0,6..0,79), M(0..0,19), S(2), Uq(0,2..0,39)}

Class III = {Sx(w), Ar(production sphere), E(0,6..0,79), M(0,2..0,39), S(0), O(0,8..1), P(0,4..0,59)}

Class IV = {Sx(m), Ar(engineer sphere), E(0,6..0,79), M(0..0,19), S(0,2..0,39), O(0,8..1), P(0,4..0,59), R(0,4..0,59)}

Class V = {...}.

Thus we can identify people who are carriers of common sets of characteristics and may differ on some of them.

5. Results review of modeling results of user model of Information networks

Existing researches in area of Information technologies investigate users as objects of reviewed area, according to research. This research, which describes main characteristics of IN user (not its relationship with IN, but itself User) has no analogs in researches of Information Networks modeling process.

The suggested approach allows to build a model user of information networks and provides flexible and dynamic to supplement of the information, and compact for further implementation of the information network model in general, reflecting the internal and external processes of interaction of these models, and must help in optimization, synthesis and management of information networks. The obtained results are continuation of researches, started in [7–9].

6. Conclusions

The results of the system analysis methods applied to fuzzy formalized object, which acts as IN user allowed:

— Capture the different classes of users as a set of attributes and their values.

— Formulate non-correlating relationships between variables.

— Formulate a formal model of IN user as fuzzy formalized objects that can dynamically change adding information without significant investment in resources and time, and is able to uniquely characterize the object of research.

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ИСПОЛЬЗОВАНИЕ МЕТОДОВ РАСТУЩИХ ПИРАМИДАЛЬНЫХ СЕТЕЙ И СИСТЕМНОГО АНАЛИЗА В ФОРМАЛИЗАЦИИ МОДЕЛИ ПОЛЬЗОВАТЕЛЯ ИНФОРМАЦИОННЫХ СЕТЕЙ

Разрабатывается модель пользователя Информационных сетей как плохоформализованного объекта. Рассмотрены и проанализированы методы кластерного анализа и растущих пирамидальных сетей. Предложено использование методов системного анализа для построения формализованной модели и структуры общности пользователей Информационных сетей относительно их характеристик и полученных в опросе данных.

Ключевые слова: информационные сети, пользователь, плохоформализованные объекты, системный анализ, растущие пирамидальные сети.

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