International Journal of Engineering & Technology, 7 (4.25) (2018) 236-239

International Journal of Engineering & Technology

Website: www.sciencepubco.com/index.php/IJET

Research paper



Semiotic Construction of an Intensive Multimedia Environment on a Cognitive Basis

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Abstract

Materials of this article are scientific-methodological development of a state-funded academic research work titled: "Researching Cognitive Semiotics in a Virtual Reality Multimedia Environment" that reflects intermediary results of the second year of the mentioned research. According to the task, a concept of model solution was built, with an introduction of a series of updating notions. This article presents it as paradigmatics on creating the project's basic ontology and mathematical models that display the model created by executors of the structural-semiotological methodology of system arrangement of virtual environments and multimedia production.

The obtained results and recommendations are used by the Moscow Technological University's Information Technologies Institute (MTUITI), department of Instrumental and Applied Software (IAS) for the course of "Methodological IT Fundamentals" for master's students specializing in "Program Engineering" ("IS Architecture" profile), for masters' and bachelors' qualification paper topics, and for post-graduate work. This paper can be helpful for professors, supporting staff, tutors and instructors, as well as, by all of the students of IAS and MTUITI

Keywords: Semiotic Construction, Multimedia Environment, *Cognitive Basis, paradigm, Managerial project*

1. Introduction

The task for the state-funded research work entails completing the project titled «Researching Cognitive Semiotics in A Virtual Reality Multimedia Environment» in 2017-2019. In that project, on the stage of task setting for the research work, while discussing the paradigm and objective definition of the project, what the researchers need to be focusing on was preordered. The basic fundamentals and applied provisions of developing semiotics as the governing methodology for creating and using contemporary highly intensive include multiple parameter, and dynamic virtual realities that work both in the multimedia content environment as well as the complex xd-mensional graphics. In that project, in the updated interpretation, the positions of cognition were created, as a bench mark and a means for instrumental influence on quality, efficiency, helpfulness and intellectual excellence of virtualizations. In order to achieve this, for the first time the scientific practice was connected to modeling, projecting and accompanying the informational systems corresponding with these characteristics, and seamless interaction between the semantic and pragmatic components of semiotics were being studied on a universal synergic basis.

This approach definitely allows, from a methodological angle, implementing a fruitful paradigm "from sense to shape" which serves as a basis for differentiating between semantic-functional types of authorized informational constructs of inferential semantics [1]. Joint review and harmonization of semantic, pragmatic and syntactical features of all of the multifaceted aggregation of elementary semantic units (ESU) for informational fields (implementing a complex approach to constructing inferential from the position wholesome semiotics that unites semantic, pragmatic and syntactic notions and raises semiotics above semantics), allows forming truly cognitive-based semantic nuclei of inferential pointed out.

Nuclei are the ontologies of corresponding informational fields serviced by semantics; their display, acceptance and embodiment instrument is a three-level projective agreement of any IT project, most of all directed at determining and reliably supporting the full life cycle of both the project as well as its product – informational system under semantic cognitive management (ideally – under Ontonet management.)

2. Research Methods

- Managerial project agreement(project management aimed, first and foremost, at providing quality of the full life cycle (FLC) of the project itself, as well as modeling algorythms generated on its basis: algorythms for modeling, construction, projecting and accompanying informational visualization and graphics systems.)
- Linguistic/platform, cross-platform project agreement(first and foremost, in terms of choosing and employing software means for both accompanying and creating before mentioned generations, as well as the project itself for all of its FLC.)
- Ontological project agreement that validizes the use of scientific updates in the methodology of cognitive dimensions and management. Correspondingly, ontolofical agreement is key in the paradigm of the given scientific research work and takes the central spot when fixating science-driven notions of the current study. Its result is the information semiotic nucleus and its semantics in shape of project ontology that either has a status or within the continuality limits of the project itself, either higher – corporate, industrial or an even wider acceptance field, eventually leading to specification generation, following with some kind of standard.

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A vivid example: an IEEEL TSC P 1484.1 specification - «An Education System Architecture Model»of the Committee on standards of education technology standards contains the whole set of key terminology in its description that is related to the ontological essence of describing the named architecture variety, all the emphasized positions for using the necessary instruments for implementing specification points in architecture formation (the pragmatic component) that allow forming highly cognitive ontology applicable in extracting knowledge from both relevant and pertinent features through norming and checking syntactical traits and forms of notion specification given in the text.

In the example given here, one taken from educational technology practice, as in the cases similar to it, when the differentiation of semantic-functional types of authorized constructions is semiotically (from positions of semantics, pragmatics and syntactics) evaluated and normed, notions and signs of pertinence and relevance of finding knowledge-like information are practically merged. Hence, high measures of cognitions and ergodity are provided for that very correspondence between the searching action and information extraction, that is, a high measure of correspondence between information distribution in response to a request from a user, user needs and expectations. An inferential aspect of semantics is discussed well and quite systemically, in context of notion authorization of the usually initially vague information field.

The paper [1] talks about the inferential aspect of semantics in context of building phrases of this or that language in a verbal sense – Russian in this case.

In our understanding, a similar approach is related to a meaning unit of document graphic informational systems. An Elementary Semantic Unit (ESU), introduced into the scientific rotation of the informational processes and systems by the Doctor of Engineering, professor N.N. Zalitchev [3]. So, from the positions of Informatiology, ESU is a non-divisive, from the possible loss of the following sense division, minimal, definitely identifiable part of conceptual objective information. For instance, a text file, picture, banner, so forth. If we try to divide these objects into parts, their sense would get distorted, their true starting identification signs would be violated or even disappear. This is obvious both in cases when we are dealing with textual materials, verbality or still imagery. In this case, semantic traits are enough in order to confidently operate through semantic notions, not semantics on the whole.

In this case, cognition is nothing but the measure of growing synentropy on each step of confident extraction of knowledge-based information on strictly semantic signs, that is on notion ontology, only ontologies. This is shown through the appearing informational phantom as a result of affecting the informational system of searching thematic request or other transactional activity. However, to the notion of other activities that have ontological consequences can be fitted into the group of filling IS with information, remitting its content and, as a consequence, temporarily growing level of generalized IS entropy – to put it simply, somewhat vague of the previously harmonized and normed ontology [2].

Everything mentioned above is mostly related to textual forms and static images in informational fields served by ontology manifestations.

However, the anthropocentrism of essential signs based only on semantics for document ographis information and static images is definitely not enough for working with multimedia information, especially that which is significantly intensified – that is, macromedia, complex computer graphics, vivid virtualization. Cognition as a measure of the above-mentioned correspondence between all the ergatic participants here suffers in the first place, since intense dynamic processes in IS (therefore, in complex ergatic IS) become wholly dependent not only on fully semantic construction, but also on pragmatic factors displaying the IS ability to steadily and efficiently open and reproduce multimedia and other complex technological dissimilar files. We are talking video codecs, multimedia file quality in terms of dimension, colorization, contrast, sound quality and a whole lot else. This is not semantics. This is pragmatics connected to semantics through only identification signs of ESU syntactics.

In other words, we are noticing a close, inseparable connection and interpenetration of semantics, syntactics and pragmatics, that is, the whokeness and inseparability of semiotics in tasks of semiotic construction on a cognitive basis if an intensive multimedia environment.

The role that is sometimes decisive in terms of working with multimedia files of technological factors, was analyzed at the very start of discussing the problem described here by the participant of the current work, D.S. Shemontchook [4] in his candidate dissertation, where, in terms of multimedia construction he introduced the complexity of evaluation with note of these technological factors into the terms of relevance and pertinence, that is, defined notions and created means of harmonization or norming technological relevance and technological pertinence.

The other participant of this project, R.G. Bolbakov, successfully presented his thesis, showing the role and impact of multimedia material technological factors of cognitive components and scores of mentioned technological relevance and pertinence [5]. For this, he introduced the model of informational morphism of multi-agent exchange of multimedia material information between subjects/objects of complex ergatic informational systems with instruments in view of cognitive entropy, that is, some kind of probable logarithmic measure of the extent of the semantic anthropocentrism for the system functioning from the positions of cognition with the consideration of multimedia material technological factors. (Here, under the semantic anthropocentrism, the authors mean concentrating philosophical semiotics studies for constructing multimedia materials through a prism of synergic approaches, viewing the aggregation of all the problems to the centrism of a human – a multimedia material user, as the main part of a complex ergatic system in the cognitive aspect.)

It appears that the ratable drift of R.G. Bolbakov to informational morphism entropy ratings developed from the initial concept that the ambiguity of an event that consists of the exact alignment between the ontological list (ontology nucleus) and morphism results in an ergodically strict additive system can be defined by numeric characteristics of the probability density function, for instance, through the use of the second central moment or dispersion. Hence the establishment of the cognitive entropy notion in the scientific practice, reviewed in the most general case as a variety of the widely known generalized entropy.

One of the explanations to the fact that ontological concurrence of the alignment between the nucleus ontology composition and IS-produced transactions of informational phantoms can be referred to situations when formal quantitative process characteristics (for instance, multimedia material stream intensity) are not much different for different transactions, but qualitative signs, especially in the technological aspect, are mostly different (as an extreme – the ability of the multimedia material file to open.)

Hence, using model approaches built on dispersion scores can look inappropriate, and a rational approach to solving this kind of task with vague consequences of IS influence is a transition from the dispersion analysis to entropy characteristics, evaluating as a measure of variety, even though there shouldn't be variety in reading ontologies from the cognitive position.

That is why [5,7] introduces and effectively uses the means of analyzing and managing multimedia content – cognitive entropy. By R.G. Bolbakov, cognitive entropy is measured in nits, that is, in natural units of measurement, presenting convenience in terms of presenting complex ergatic systems in informational morphisms in multimedia with the use of productive mathematical apparatus of integral and differential equations.

3. Results and analysis

Two great circumstances following from the above mentioned statements open a wide road to researchers in terms of using cognitive entropy analysis to complex informational ergatic multimedia systems from positions of cognitive semiotics:

First of all a model and mechanism of cognitive entropy with the use of integral equations by Alexander Vladimirovitch Kaganov (2000) allows effectively to follow informational morphims of multimedia systems from the positions of both semantical and pragmatical complexity in the composition of semiotics. This approach opens the possibility to introduce complexity measures for a mathematical description of morphisms as a set of certain values, characterizing technological possibilities and resources of multimedia systems from the positions of pragmatics, which, in the end, amply bonds such a universum to known entropy formulas from A.R. Mak and complexity from A.N. Kolmogorov. Ergo, a notion of integrated or complex cognitive entropy is formed. If, from some measure of approximation, processes and events served by this value are to be considered seamless, its measurability is still in nits. In other cases, when there is a prevailing interest to the measure of systematicity (to the emergence index), it can be measured in nitheartleys (this kind of dimension is rare in scientific literature.)

Secondly. The above-mentioned differential equation mathematical apparatus in appendix to cognitive entropic paradigm opens big opportunities for developing and efficiently using various cognitive entropic analysis types with preventive extraction of reference factors and traits. For instance, if the search and processing sequence of multimedia information involves an obligatory algorythm of this sequence or its part, for example, the obligation of the anti-virus check activation prior to the attempt to open a multimedia file, then notion and instruments of relative cognitive entropy successfully enters the battlefield. Uniting the aggregation of differential equations into a single field, ones that describe the dynamics of multi-step multi-factor differential scores of informational morphisms through evaluating means of the relative cognitive entropies aggregation always lead to evaluating compatible event probabilities in shape of corresponding value matrixes received through these entropic means.

Similar perspectives are opened when using the paradigmatics of cross and relative cognitive entropies as means to evaluate semiotic approaches to managing informational morphisms of multimedia. So, for instance, cross cognitive entropy displays the dispension of event probability and signs between two multimedia system agents or the aggregation of consecutive or paired combinations, discovering the properties and the amount of generated informational phantoms and multimedia environments ample for confident cognitive tertability and pertinent use of corresponding multimedia ESU. A differential analysis allows relatively easily discerning divergence (semantic and/or pragmatic technological remoteness) of Kullback–Leibler, that is, cognitive pragmatic relative entrapy here, informational divergence, called the Kullback divergence (here defining the “ontological/pragmatical distance”.)

From the point of view of cognitive semiotic scores, just as interesting are the alpha cognitive entropy, W cognitive entropy, epselont cognitive entropy, epsilon cognitive entropy as a measure of complexity (in the development of A.N. Kolmogorov’s epsilon entropy), Renyi’s cognitive entropy of varieties and many other approaches that allow evaluating properties, functions and displays of complex ergatic multimedia systems and systems used to influence them.

In any case, even at the current intermediary stage of research discussed, one can confidently say that the usage of described cognitive entropic means, approaches and instruments undertaken by the authors of this article for the unfolded, universal ontology of informational processes and systems presented[6,8] gave the most promising results to continuing researche in the direction presented.

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