

this kind of interpreter. On the contrary, the problem lies in the model of asynchronous access to sc-memory, which prevents the collection of sc-agents that are part of the Implementation of the SCP Language interpreter to work smoothly. To implement a full-fledged collective of ostis-systems interacting with each other, it is necessary to transfer the Software implementation of the ostis-platform from the specialized ostis-platforms class to the basic ostis-platforms class. Thus, it is necessary to switch to a new version of the ostis-platform (not a modification (!)), which will contain the current Implementation of the SCP Language interpreter.

- The current Implementation of ostis-platform scmemory is efficient for storing large amounts of knowledge in ostis-systems knowledge bases. However, in information retrieval problems, rather complex tools and subsystems are required to ensure the most effective solution of these problems. So, for example, to find all pairs of a given relation whose first component is a given sc-element, it is necessary to check the entire list of outgoing sc-connectors of a given sc-element, including those sc-connectors that do not have the specified syntactic or semantic sc-element class. The solution to this problem is possible by modifying the existing Implementation of ostis-platform sc-memory, namely, the implementation of a new sc-memory model (for example, on the file system of the modern Linux operating system).
- Implementation of the OSTIS Ecosystem [20], [21] requires strong development of the Implementation of the subsystem for interacting with the external environment using languages of network interaction, with the help of which ostis-systems, which are developed on the current Software implementation of the ostisplatform, will be able to fully communicate with each other. The transition of Software implementation of the ostis-platform from the class of server platforms to the class of clientserver platforms is required.

## VII. CONCLUSION

Let us briefly list the main provisions of this work:

- The current Software implementation of the ostisplatform is cross-platform, which allows:
  - developing and maintaining the state of its components, regardless of the implementation of the platforms on which the tools for their design and development are used;
  - using it to solve problems on any available devices.
- The current Software implementation of the ostisplatform is multi-user, that is, it allows processing several actions at the same time.
- The current Implementation of memory in the ostisplatform is complete enough to: – one-to-one interpret sc-models of ostis-systems, including

external information constructions that do not belong to the SC-code; – develop platform-specific components that require access to sc-memory (for example, the Software interface of Implementation of ostis-platform scmemory).

- The current Software implementation of the ostisplatform is specialized, that is, it allows creating only platform-dependent ostis-systems.
- On the basis of the current Software implementation of the ostis-platform, the interpreter of sc-models of ostis-systems user interfaces, interpreter of logical models for solving problems in ostis-systems, as well as the manager of reusable ostis-systems components are used.

In this article, the principles underlying the Software implementation of the ostis-platform, the principles of documenting its components, as well as the prospects for further development are described.

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## Принципы проектирования, структура и перспективы развития Программной платформы ostis-систем

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Данная работа является краткой спецификацией текущего Программного варианта реализации ostis-платформы. Работа показывает принципы, структуру и перспективы развития программной платформы для логико-семантических моделей систем, построенных по принципам Технологии OSTIS.

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# Implementation of Information Retrieval Subsystem in the Software Platform of ostis-systems

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**Abstract**—The article describes the purpose and implementation variants for information retrieval subsystems of next-generation intelligent computer systems. This paper is a formal specification of how the information retrieval subsystem in the current Software implementation of the ostis-platform, as well as its software interface, are implemented, and is a continuation of a series of works on the design and implementation of the basic Software implementation of the ostis-platform [1], [2].

**Keywords**—information retrieval, information retrieval problem, isomorphic search, graph template, graph information retrieval system, ontological design, graph storage, ostis-platform

## I. INTRODUCTION

One of the most important tasks of *intelligent computer systems* [3] is to satisfy the information needs of users. *Intelligent computer systems* should not only find the necessary (relevant) information for the user, but also provide quality answers to the user's questions. Thus, *intelligent computer systems* based on *graph representation of knowledge* should include entire software complexes for searching information relevant to the user — *graph information retrieval subsystems* [4], [5], [6].

Existing *graph information retrieval systems* are based on the use of *graph algorithms* for searching, storing and presenting information [7], [8]. Graphs are used to model relationships between objects, such as web pages on the Internet, users on social networks, or others. In such systems, users can use search queries to find information in a graph. Queries may be similar to those used in traditional information systems, but instead of searching by keywords, the user searches for objects and the relationships between them.

*Information retrieval tasks* are of great relevance, since at present the amount of information available on the Internet is too large for a person to handle without using appropriate search engines [9]. Information flows are growing every day, and therefore a more efficient

and accurate use of information is becoming increasingly important for decision-making, planning, scientific research and other activities. Moreover, the ability to conduct high-quality and accurate information searches is a key skill for people in the modern world.

## II. EXISTING ANALOGS OF GRAPH INFORMATION RETRIEVAL SYSTEMS

Modern *graph information retrieval systems* use the *PageRank* [10] algorithm to determine the relevance of search results. PageRank evaluates the importance of each object in the graph based on the links it contains from other objects, and those objects that are considered more important are ranked higher. Graphs also allow the use of analytical algorithms, such as community detection algorithms, to identify subgraphs that group objects according to certain criteria. This can help users find information that might not be found in a traditional keyword search.

Examples of *graph information retrieval systems* are *Google Knowledge Graph* [11], *Facebook Graph Search*, *LinkedIn Skills Graph* [12] and *Neo4j* [13].

The use of *graph data models* in solving *information retrieval tasks* is explained as follows:

- Data processing performance is improved by one or more orders of magnitude when representing data as *graphs*, due to the properties of *graphs* themselves. Unlike *relational databases*, where query performance degrades as the dataset grows with increasing query intensity, *graph data model* performance remains constant even as the dataset grows. This is due to the fact that data processing is localized in some part of a *graph*. As a result, the execution time of each request is proportional only to the size of the *graph* part traversed to satisfy this request, and not to the size of the entire *graph* [14].
- *Graph data models* have tremendous expressive power. *Graph databases* offer an extremely flexible data model and way of representing it. *Graphs* are additive, which provides the flexibility to add new data relationships, new nodes, and new subgraphs

