Construction and Application Technology Architecture of Domain-specific Knowledge Graph in Military Field

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Abstract: Domain-specific Knowledge Graph in Military Field is a bridge to connect all kinds of battle factors, such as combat forces, command system, weapon platforms. It’s also an important means to break through the information gap between different areas of different services. Most of the existing knowledge graph is general knowledge graph for general fields, but there is no mature method of knowledge graph construction and expression for the industry data of military specific fields. So based on the special needs for military knowledge acquisition, storage, representation, query and other technologies in the future information and intelligent operations, and application scenarios, this paper discusses the current opportunities and challenges of the knowledge graph in military domain. Then the construction of knowledge graph in military domain and application technology framework are proposed.

1. Introduction
Domain-specific Knowledge Graph (DKG) refers to the Knowledge Graph focusing on a specific vertical Domain, the entities and concepts are almost related to the Domain.

Domain-specific knowledge graph is used to assist a variety of complex analytical applications or decision support, different domain construction schemes and application forms are different. As a knowledge container and incubator in artificial intelligence technology, knowledge atlas will play a key role in the future development of AI field. In the future, the way of war will be changed to the joint war based on the network information system. Information has become an important link linking all kinds of war units, such as troops, weapons and equipment, and information system. It is urgent to organize, relate, share and develop these information resources, so as to break through the information gap and gain the advantage of war information.

This paper preliminary discusses the opportunities and challenges of domain-specific knowledge graph in military field. Construction and application technical architecture of knowledge graph, is given to illustrate the application of the DKG in military field scene, according to the characteristics of the military field of whole life cycle of knowledge process each link of the key techniques of special research, aims to promote knowledge graph be born in the military field application, the data of the network information system construction association building, data organization and knowledge management has a certain guiding significance.

2. Research background and related work of DKG
In foreign countries, domain-specific knowledge graph can be regarded as a "structured encyclopedic knowledge base" for the general domain because the knowledge of generic knowledge graph is derived from data of various structures, and DKG are also called industry knowledge graph or vertical knowledge graph, which are oriented to a specific domain. DKG is based on the construction of
industry data and usually has a strict and rich data pattern, which requires high depth and accuracy of knowledge. Therefore, it is urgent to solve key problems such as enhancing the representation ability of domain knowledge, identifying and extracting relationship of domain entities, and discovering implicit relationship.

Current research achievements of domestic military DKG is less, gold instant car based on military equipment of encyclopedic knowledge knowledge graph construction and application are studied, build the knowledge graph in the field of military equipment, realize the function of knowledge quiz, but only based on the public of semi-structured data, single data source, data types, and there is no clear knowledge extraction accuracy in the research, the degree of automation and accuracy of knowledge quiz results; Zhou Lina et al. studied the construction method of knowledge ontology of network information system, and believed that the current problem was to solve the automatic construction and update of ontology, and the knowledge graph could not cover all military activities.

3. Application scenarios of DKG in military field
Application scenarios mainly include intelligent question-answering based on military knowledge, personalized recommendation, covert knowledge reasoning and other auxiliary data analysis and decision-making functions based on knowledge graph.

From the point of view of the questions raised by users, in addition to the traditional declarative questions, DKG focuses on the problem of interpretation. Simple declarative questions such as "what", "who", "when" and "where" can only meet users' basic requirements for knowledge graph. Now more and more scenarios require solving explanatory questions such as "why" and "how".

War fighters' requirements for combat data are diversified and personalized, and the results obtained by information retrieval system represented by search engine cannot meet their personalized needs well. Such problems can be solved by personalized recommendation based on DKG. It can support the application scenario with a long reasoning chain, and can deduce hidden knowledge based on deeper relations. It can also describe user habits according to user's statistical data and carry out hidden knowledge reasoning. The application of intelligent question-answering, personalized recommendation and covert knowledge reasoning based on DKG can significantly improve the organizational efficiency of daily training and save equipment and human resources.

4. Construction and application technology architecture
The general knowledge graph emphasizes the breadth of knowledge and is constructed from the bottom-up approach of encyclopedia data. DKG is oriented to different fields, with different data patterns and application requirements. Therefore, it needs to be guided by a set of common standards and specifications, and customized implementation is based on industry characteristics and expert experience. Knowledge graph construction and application in the military field is a systems engineering, and its construction process is divided into six links from scratch, in this paper, referred to as DKG of whole life cycle, the key technology of its design process mainly include knowledge representation, knowledge storage, knowledge extraction and knowledge integration, knowledge calculation, calculation and evolution, knowledge application [1], as shown in figure 1.
Figure 1 Construction and application technology architecture of DKG in military field

Data layer is the foundation of the whole DKG construction, different from the traditional Internet data, military field data sources and different types, including military database, combat text, images, documents, information, military of multi-source heterogeneous data such as streaming media, mainly comes from military standard database, and the existing/in information systems research model to obtain the information such as the target information.

4.1. Knowledge representation
Knowledge representation defines the basic cognitive framework of the domain, clarifies the basic concepts and semantic associations between concepts, and provides the basic framework and data structure of machine cognition to achieve a reasonable organization of knowledge [2].

There are two issues that need to be addressed in the military domain knowledge representation. First, the general knowledge graph is not enough to express all the semantics, such as the application scenarios of equipment maintenance and configuration in the military field, and it is difficult to express if-then rules. For example, if A and B then C, it is difficult to express atomic expressions with complex relationships. Second, fine-grained knowledge representation is one of the strong requirements for military applications, but it does not mean that all application scenarios need fine-grained representation. The finer the expression capability is, the higher the acquisition cost is.

4.2. Knowledge storage
Knowledge management is mainly about storing knowledge, establishing index and realizing efficient inquiry of knowledge. DKG in military field also has diverse and heterogeneous knowledge, which is characterized by multi-source, heterogeneous, timing, real-time, redundancy, strong correlation and closed-loop. The knowledge representation has the following difficulties: First, the traditional XML storage mode is not suitable for the analysis and modeling of unstructured, semi-structured and structured data; Secondly, the correlation between concepts and instances in the DKG is very complex. Traditional ontology editing tools are stored in the form of RDF or OWL. As there are copies of the data in memory, it is not suitable for the storage of large amounts of data. Third, Neo4j, which is used by general Knowledge graph, will affect the speed of all kinds of data query and modification when it supports the complex use scenario of military Chinese knowledge graph. In conclusion, a reasonable storage mechanism must be used to satisfy the high concurrency and high speed query.

4.3. Knowledge extraction
Knowledge extraction is to fill the knowledge of the knowledge framework instance, it is important to note the quality of access to knowledge and completeness problem: one is for all kinds of large-scale
military information systems at all levels in the use of complex multitasking environment produced a large number of military data, the data characteristics of existence of a variety of data source, data format, need according to the characteristics of the different data, designed to improve the key to knowledge extraction accuracy and recall rate means, such as military database has inconsistent data representation, data was unable to complete the retrieval problem of the convergence and intelligent; The combat documents have high complexity, many special data and strong data rules, so it is necessary to inject corresponding military rules in advance[3-4].

4.4. Knowledge fusion
With more diverse data sources and different extraction ways, from a knowledge extraction in entity, relationship and attribute data redundancy, noise, incomplete and uncertain problems, such as, at the same time, the relationship between the data level and clear logical relations, such cleaning link cannot solve in the problem through the knowledge extraction, an urgent need to build the said entity relationship model based on integration. For different fields, data patterns and application requirements, complete data semantic standards and links for massive heterogeneous data resources, conduct entity disambiguation and entity alignment, realize cross-domain semantic fusion of multiple DKG, and form a globally unified knowledge representation and association [5-6].

4.5. Knowledge computing and evolution
In order to improve the practical application value of knowledge graph in military field, it is necessary to excavate a large number of implicit relationships among entities. As a result the DKG in military field entity distribution is relatively dense, relative knowledge of a single entity coverage, in allusion to the granularity of the knowledge representation and depth, the characteristics of the deeper too fast load incremental knowledge and rules, to complete a long reasoning, ensure the ductility and the correctness of the reasoning, mining more related information and knowledge of semantic level [7].

In addition, the construction of military knowledge graph is a process of continuous iteration and update, and the operational plan, strategy and means are constantly changing, which requires timely confidence assessment of knowledge and improvement of new knowledge [8].

4.6. Knowledge application
Knowledge applications need to consider technology maturity and avoid "graph for graph's sake", so use scenarios carefully. The application of military knowledge should clarify the application scenario and the application mode of knowledge, namely, the problem to be solved. The first is what kind of application scenarios can use knowledge atlas. As an open knowledge management mechanism oriented to man-machine collaboration, knowledge graph has specific value and cost. For different application problems, knowledge graph is not always the best solution. Second, the application scenarios of DKG in military field are much more complex than those of general knowledge graph. Most of the current domain knowledge systems are built with the basic concepts and entities of domain data as the center, which has natural defects in understanding user requirements in complex application scenarios. How to better design the complex combat application scene and bridge the semantic gap is the key problem in knowledge application.

5. Conclusions
The construction of DKG in military field is the basis of the intelligent development of war command and one of the important technologies to improve the level of auxiliary decision making of combat data. This paper puts forward the construction and application technology framework of DKG in military field, describes the difficulties and key technologies in each link of the whole life cycle, and hopes to provide theoretical and methodological support for the design and construction of DKG in military field.
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