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Research on the construction of knowledge ontology for intangible cultural heritage

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Abstract

[Purpose/significance] This paper uses RDF triplet and ontology as the description framework to explain the knowledge structure and data association of "intangible cultural heritage" data resources, uniformly model and store fragmented "intangible cultural heritage" data resources, and realize the data prototype of visual expression, which is conducive to enriching the theoretical research on digital protection of "intangible cultural heritage" resources and the "living" inheritance of intangible cultural heritage. [Method/process] to build a knowledge ontology model in the field of intangible cultural heritage. Firstly, the structure of intangible cultural heritage knowledge is analyzed; Then, the visual construction of knowledge ontology is realized in Protégé, and the idea of semantic association visualization based on knowledge ontology is proposed; Finally, take Dujiazhuang woodcut New Year pictures as an example for empirical research. [Results/Conclusion] Intangible cultural heritage domain knowledge ontology describes "intangible cultural heritage" data resources from a fine-grained level, providing a way of semantic description and data association organization for "intangible cultural heritage" data resources.

Keywords

intangible cultural heritage, digital resources, knowledge ontology, metadata

1. Introduction

Intangible cultural heritage (hereinafter referred to as "intangible cultural heritage") is an important part of the history and culture of a country and a nation, with distinctive regional cultural characteristics. Countries generally attach importance to the protection and inheritance of cultural heritage, and the protection and development of cultural heritage has become a worldwide topic [1]. With the continuous promotion of intangible cultural heritage protection in China, under the background of information technology era, digitalization has become the main means of intangible cultural heritage protection, especially the rapid development of artificial intelligence and big data technology, promoting the deep integration and application of new generation information technology and non heritage inheritance.

2. Research status

At present, there are many researches on the construction of intangible cultural heritage digital resource library and sharing platform, which basically realizes the classified display of intangible cultural heritage digital resources in the form of text, image, video and other forms, and can build corresponding resource library and sharing platform for specific examples [2]. However, this way only realizes the simple reproduction and classification of intangible cultural heritage data, and this linear listing causes the content of intangible cultural heritage resources to be scattered, incoherent, and fragmented. However, the digital resources of intangible cultural heritage are characterized by diversity and heterogeneity, which makes it difficult for this knowledge organization mode to reveal the connotation and tacit knowledge of intangible cultural heritage, and also to construct the semantic association of intangible

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cultural heritage knowledge, greatly limiting the integrity and transmissibility of intangible cultural heritage knowledge. Based on this, this paper takes RDF triples and ontology as the description framework, refers to the ontology structure model of intangible cultural heritage knowledge, proposes a semantic description model suitable for the description of intangible cultural heritage knowledge, and designs knowledge extraction based on this, extracts the knowledge contained therein in a structured form, so as to achieve effective integration of semantic understanding, semantic retrieval and intelligent content push, It provides a basis for the semantic organization and visual expression of intangible cultural heritage digital resources. Finally, it conducts an empirical analysis with Dujiazhuang woodcut New Year pictures. Through data collection and processing, it forms a knowledge ontology, promotes the development of intangible cultural field to knowledge organization, and promotes the protection and inheritance of intangible cultural heritage.

3. Research on knowledge ontology in intangible cultural heritage field

At present, there are many mature ontology models in the field of intangible cultural heritage, such as CIDOC CRM, FRBR, etc. CIDOC CRM concept reference model provides a conceptual framework based on semantic understanding and knowledge sharing by defining the semantic relationship of concepts in the cultural field. It is a knowledge ontology model in the cultural field. Its purpose is to describe and understand the concepts and relationships in cultural heritage through the knowledge ontology of cultural heritage information.

In the research of knowledge organization in intangible cultural heritage field, ontology and metadata are the focus of attention. As a formal model in the field of artificial intelligence, ontology, because it contains rich semantic information, has obvious advantages in knowledge representation applied to intangible cultural heritage data, provides a basis for semantic organization and visual expression of intangible cultural heritage digital resources, promotes the development of intangible cultural heritage field to knowledge organization, and promotes the protection and inheritance of intangible cultural heritage. In terms of the construction of intangible cultural heritage knowledge organization, most scholars have done relevant research from different perspectives. For example, Cai Lu analyzed various elements of intangible cultural heritage from the perspective of system theory in the Construction of Knowledge Organization System for Intangible Cultural Heritage Resources Based on Ontology and Metadata, built an ontology model composed of concepts such as project class, person class, event class and event class, and formulated metadata standards for intangible cultural heritage data resources. Teng Chun'e organized and integrated the Hezhe intangible cultural heritage data resources from the dimensions of intangible cultural heritage projects, characters and events based on ontology theory in the Research on the Construction of Knowledge Organization Ontology of Intangible Cultural Heritage Resources. Wei Qinghua discussed the three-dimensional organization, management and display of intangible cultural heritage knowledge through intangible cultural heritage ontology and associated data technology in the Construction of Intangible Cultural Heritage Knowledge Base. He Chunyu mentioned in the Construction of Intangible Cultural Heritage Knowledge Ontology that by introducing knowledge ontology and data association technology, intangible cultural heritage resources can be formed into structured semantic knowledge units, and ultimately achieve the retrieval, visualization and knowledge concept sharing of intangible cultural heritage resources. To sum up, the semantic organization of resources in the cultural field is mostly based on the research ideas of ontology and metadata. It not only uses CIDOC CRM, FOAF, EVENT and other models, but also realizes the association and mapping between resources and other human resources such as text. However, in terms of cultural resource organization, there is still a lack of research on the characteristics, hierarchical structure and standardized

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terms of cultural resources.

4. Ontology construction of intangible cultural heritage resources

4.1. Intangible Cultural Heritage Ontology Construction Process

(1) Establish the concept set of intangible cultural heritage resources.

First of all, we interviewed domain experts, collected and sorted out domain knowledge, and determined the meta concept of intangible cultural heritage resources. The concept is not only limited to domain knowledge, but also should integrate connotation and extension concepts. Then the concept is structurally analyzed to make the knowledge information have structural characteristics, which can realize the rapid modeling of subsequent ontology.

(2)Realize the knowledge reorganization between concepts and visualize their structure.

After sorting out conceptual relationships and structural analysis, concepts and relationships are represented by charts. Concepts and relationships mainly include things, attributes and rules. Domain knowledge relationship models are built. This cross infiltrated network structure model system has stronger visibility to facilitate the query and expression of relationships.

(3)The construction of knowledge association model is realized by computer software.

Based on the core concepts of the domain, according to the domain ontology and semantic description rules, the relationship between concepts is determined by manual annotation, and the RDF form of triples is marked. Protégé is widely used as an ontology development tool because it is freely available and easy to operate.

According to the characteristics of intangible cultural heritage archives resources, this paper chooses protégé, a relatively easy to use and relatively simple ontology construction tool, as the ontology construction tool of intangible cultural heritage resources. Protégé is developed by Stanford University Research Center based on the java language. It can be downloaded and used for free and supports a variety of file output formats, such as XML, RDF (S), OWL, etc. It provides the construction of concept classes, attributes, instances and rules in the domain ontology, and uses graphical interfaces. With clear functional partitions, it has good scalability, and can also perform a series of special functions, such as reasoning, questioning, etc. Therefore, this paper uses protégé to construct the domain ontology of intangible cultural heritage. Use OWL language to formally describe the defined concepts and relationships. As shown in Figure 9.

4.2. Determination of the conceptual system in the field of intangible cultural heritage resources

When modeling the domain ontology of intangible cultural heritage resources in this paper, after selecting the ontology domain and category, first analyze the feasibility of domain ontology construction, and then define the important concepts in the domain ontology through the domain experts, list the central class and its subclasses, and define the attributes of the class. This paper refers to the CIDOC Conceptual Reference Model (CICOC CRM for short) in terms of ontology construction, concepts, classes, attributes and relationships of intangible cultural heritage resource domain. Domain ontology is to transform the concept of a certain domain into a concept that can be recognized by the machine through semantic description, and achieve information description based on knowledge level on the semantic level. According to the characteristics of intangible cultural heritage resources, the core categories

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include intangible cultural heritage projects and people, institutions, events, documents, things, etc. The association between examples is revealed by category attributes (as shown in Figure 1).

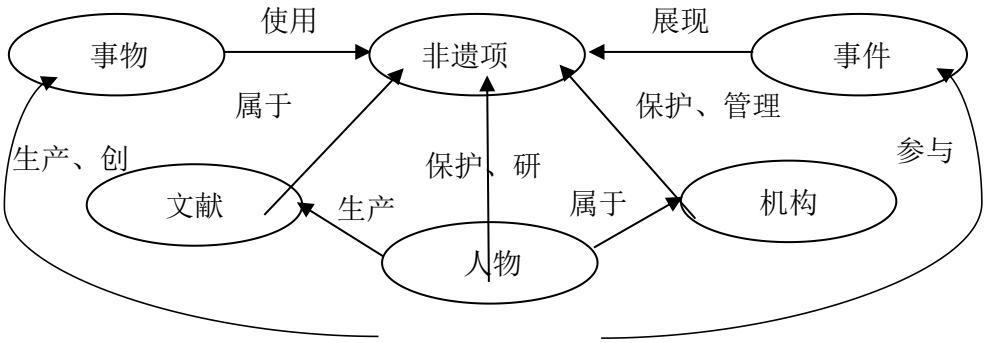

Figure 1: Ontology conceptual model

4.3. Semantic organization framework of intangible cultural heritage resources.

This study proposes a semantic integration framework for intangible cultural heritage resources, which is divided into four layers: source data layer, semantic layer, data association layer and application layer. The form of source data layer includes document file, web page information, oral language, etc. It provides basic data for the upper information processing layer and is the basis for ontology based knowledge extraction. The semantic layer triples the ontology resources of intangible cultural heritage data, sorts out knowledge and relationships, and converts them into metadata in the form of triples. The data association layer associates the triplet RDF metadata to the semantic layer for publishing, which can provide a unified view of the upper semantics. The application layer develops and realizes various semantic applications in the upper layer, such as semantic retrieval, knowledge visualization, knowledge reasoning and other services [8].

4.4. Instance addition and information release.

Based on the semantic organization and metadata standards of intangible cultural heritage data resources, create an instance library of intangible cultural heritage data resources. The specific examples include the introduction of intangible cultural heritage, geographic information, inheritor information, and event information. The construction method is mainly to use mapping to achieve RDF of intangible cultural heritage data. Finally, with the help of relational databases to store intangible cultural heritage information, relational databases are published as associated data and provide semantic query and retrieval interfaces.

5. Construction of knowledge ontology of intangible cultural heritage of Dujiazhuang woodcut New Year pictures

In terms of the construction of the intangible cultural heritage knowledge ontology of Dujiazhuang woodcut New Year pictures, referring to the international standard CIDOC CRM conceptual model in the field of cultural heritage, the concept of information resources in woodcut New Year pictures is extracted to establish a conceptual framework. Then, the semantic calibration of knowledge ontology is carried out, and a prototype of woodcut New Year pictures knowledge ontology database based on semantic organization is established. The specific process is mainly divided into the following four steps:

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5.1. Analysis of intangible cultural heritage knowledge elements and determination of construction methods.

Intangible cultural heritage knowledge involves people, objects, time, place and intangible cultural heritage project itself. Intangible cultural heritage projects refer to the people involved in each specific project included in the National Intangible Cultural Heritage Protection Directory, which refers to the inheritors of intangible cultural heritage, sponsors and participants of relevant activities. The objects involved in the project refer to the relevant information, research results and representative works of intangible cultural heritage culture. The time involved in the project refers to the time of its publication, the time of important activities in cultural development, etc. The place involved in the project refers to the region/unit applying for the project Distribution area, etc. Intangible cultural heritage knowledge elements are shown in Figure 2.

Figure 2: Intangible Cultural Heritage Knowledge Elements

Based on the particularity of the intangible cultural heritage ontology, this paper uses artificial methods to build the intangible cultural heritage ontology. The seven steps method is a classic ontology construction method. Its main idea is to abstract the main terms of ontology into categories, then define the attributes of categories and construct instances, and construct domain ontology through seven steps. This paper will use the seven steps method combined with CIDOC CRM metadata reference model to build the intangible heritage ontology.

5.2. Establishment of the concept class of woodcut New Year pictures

In the field of cultural heritage ontology research, CIDOC CRM concept reference model, as the international standard of cultural heritage information, can improve the reusability of ontology and the sharing between ontologies. This paper focuses on the CIDOC CRM model. First of all, we conceptualize the information resources in the woodcut New Year pictures and establish a conceptual framework. The core concepts mainly include: the subject of intangible cultural heritage, namely, people and institutions; Intangible cultural heritage objects are things and events; Intangible cultural heritage achievements refer to items, documents, databases, artistic talents and other intangible cultural heritage record carriers. Therefore, relevant categories are established, including people, institutions, things, events, projects, documents, etc. As shown in the figure.

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Figure 3: Ontology concept class and its hierarchy

5.3. Establishment of concept attributes of woodcut New Year pictures

After defining the concept of ontology, it is necessary to determine the conceptual attributes of ontology. Conceptual attributes include object attributes and data attributes. Object attributes describe the relationship between concepts and semantically link the original independent concepts. The ontology object attributes constructed here are partly derived from CIDOC CRM ontology model, and the other part is expanded according to the particularity of woodcut New Year pictures.

Figure 4 shows the object attributes and their hierarchies of the ontology created using the Protege ontology editing tool. Object attributes are used to represent the relationship between intangible cultural heritage items and things, participants, places, times and types. On the one hand, it makes the relationship between ontology concept classes and object attributes correspond, on the other hand, it provides grouping management for the expansion and improvement of ontology attributes.

Figure 4: Ontology concept attribute and its hierarchy

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Data attributes describe the relationship between conceptual classes or instances and data. According to the characteristics of woodcut New Year pictures, the ontology data attributes defined in combination with relevant data are shown in Figure 5. Among them, data attributes are grouped in a way similar to the ontology concept class, mainly including the attributes of things, participants and items. The object attribute includes the description of the representative works and literature/information of the project, in which the representative works include the name, region and era; Literature/information includes creation time, source and other information. The attributes of participants include the information of inheritors and protection units of intangible cultural heritage projects. The project attribute contains the basic information of the intangible cultural heritage project number, category, declaration area and other records. So far, the concept classes and attributes of the ontology have been determined.

Figure 5: Data attributes and their hierarchy

According to the constraints of the definition domain and value domain, add constraints in Protege software to achieve semantic association and connect the original independent concept classes. Figure 6 shows the relationship between the concept classes and object attributes established by the ontology, and the connection lines correspond to the object attributes established in Figure 4.

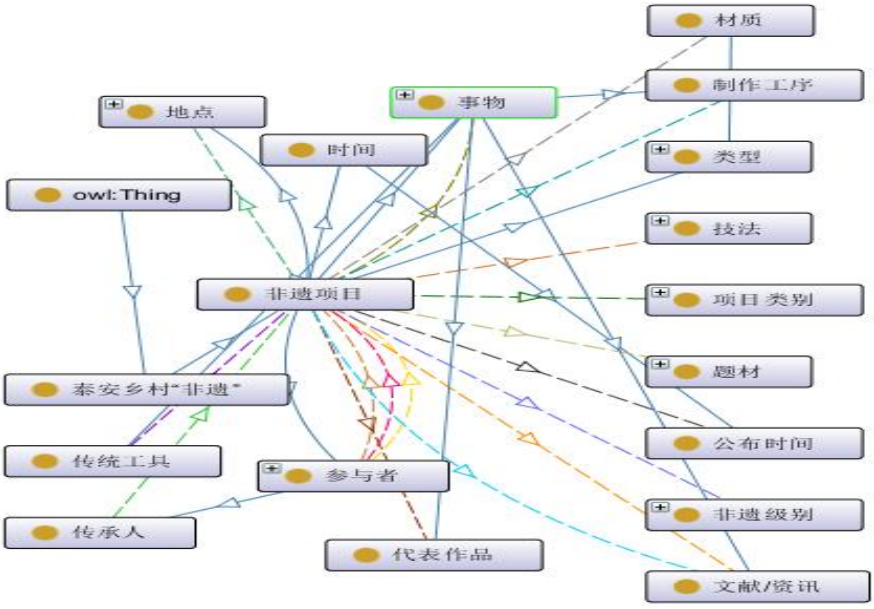

Figure 6: Conceptual class and object attribute association

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5.4. Example addition of woodcut New Year pictures

After defining the concept classes and attributes of the ontology, you need to add instances of woodcut New Year pictures. Obtain the intangible cultural heritage data of woodcut New Year pictures through early research, and then extract keywords, keyword groups and key sentences from the text corpus of intangible cultural heritage data for example expansion. After obtaining the instance information, use Protege software to create the instance, and add its corresponding data attributes and object attributes, finally realizing the semantic description of the project instance. Figure 7 illustrates the relationship between lines of different colors.

Figure 7: Description of connection relationship

After the definition and modeling of all classes, attributes, individuals and individual attributes are completed, a complete ontology knowledge map of intangible cultural heritage of Dujiazhuang woodcut New Year pictures is formed, as shown in Figure 8.

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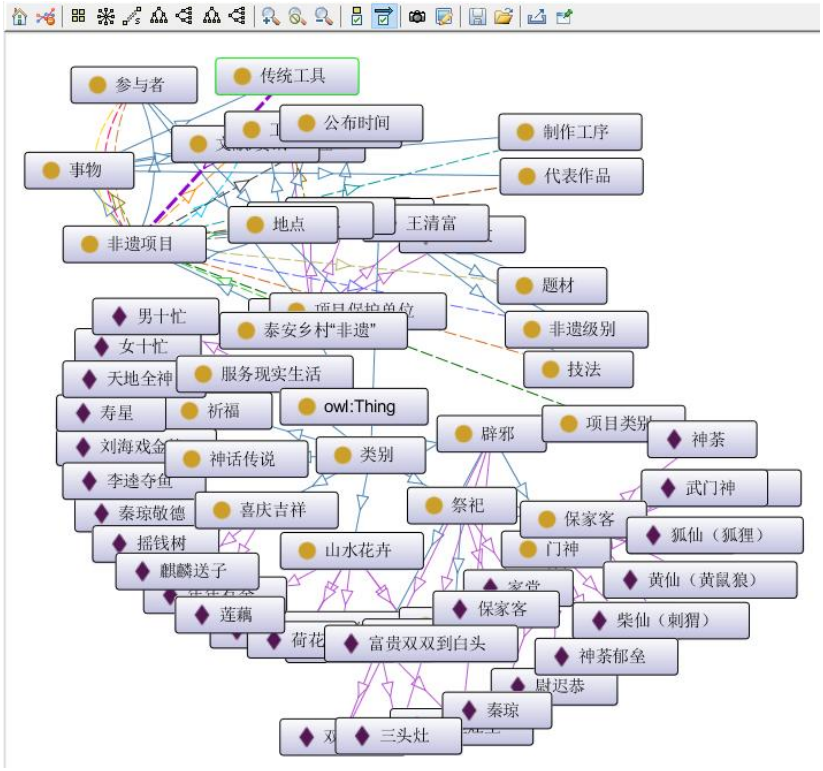

Figure 8: Instantiation interface of woodcut New Year pictures (excerpt)

Figure 8 shows some examples of woodcut New Year pictures visualized by using OntoGraf plug-in in Protege software. Centered on themes and categories, the figure shows the diversified themes and categories of Dujiazhuang woodcut New Year pictures. It can be seen from the figure that the themes displayed in the New Year pictures are closely related to the traditional culture and customs of the Tai'an people. There are family halls, the God of Wealth, the God of Family, the God of Whole Life, the Kitchen Horse, the God of Door, the King of Cattle and Horse, and the Temple of Heaven and Earth. The main purposes of the New Year pictures are to offer sacrifices, pray for blessings, ward off evil spirits, celebrate and make money. In terms of classification, they mainly pray for good fortune and exorcise evil spirits, celebrate good luck, originate from classical myths and legends, depict landscapes and flowers, and serve real life. The representative New Year pictures of blessing category include "God of Heaven and Earth", "Longevity Star", and the representative New Year pictures of exorcism category include "Kitchen King" and "Door God"; The types of door gods include cultural door gods, martial door gods and doorboys. The martial door gods are Qin Qiong and Yuchi Gong; The festive and auspicious New Year pictures are represented by "money tree", "unicorn giving children away", "annual surplus", etc; The New Year pictures for sacrificing ancestors are mainly Jiatang and Baojiake, and their types are Changxian (snake), Chaixian (hedgehog), Huangxian (weasel) and Fox (fox); The New Year pictures originated from classical myths and legends have a long history, including those we know as "Qin Qiong Jingde", "Liu Hai plays the golden cicada", and "Li Kui seizes the fish". The most famous New Year pictures depicting landscapes and flowers are "The Rich and the Noble Double to the White Head", "The Lotus Is Red in the Sun", etc.

6. Conclusion

Intangible cultural heritage is the cultural treasure of all nations, and innovative development is the only way for intangible cultural heritage to be passed on and continued in a living way.

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This paper starts from the research status quo of intangible cultural heritage resources ontology at home and abroad, combs the research ideas at home and abroad, designs and constructs an ontology model for a specific intangible cultural heritage project, constructs a semantic description model, and provides a new method for the digital protection of intangible cultural heritage resources. Finally, take Dujiazhuang woodcut New Year pictures as an example to test the effectiveness and practicality of the model. The results show that this method can realize the multi-dimensional fine-grained organization of resources in the field of intangible cultural heritage, and reveal the dynamic relationship between knowledge elements in the field of intangible cultural heritage. It solves the problems of insufficient fine-grained, low semantic level, and weak relevance that commonly exist in the traditional resource organization in the field of intangible cultural heritage, and provides reference for the digital protection of resources in the field of intangible cultural heritage, which is conducive to the inheritance and protection of intangible cultural heritage. However, there are also some deficiencies in this study. In the future, we will continue to improve and perfect the knowledge meta ontology model in the intangible cultural heritage field, and expand the empirical research and practical exploration of semantic organization in the intangible cultural heritage field.

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