

# Research on Knowledge Service Model System of American University Intelligent Library based on Computer Big Data Technology

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## Abstract

**This paper presents an ontology-based information service system framework for digital libraries. This paper takes American universities as an example to study the mobile cultural service system of libraries and analyze the function of the system. This system mainly includes information user layer, service platform layer, service module layer and service resource layer, which can carry out general and personalized mobile cultural knowledge service and sharing among different types of information users and different types of cultural information resources.**

## Keywords

**Computer; Big Data; Intelligent Library; Knowledge Service Model System.**

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## 1. Introduction

At present, digital library has become the main information environment supporting national scientific research and teaching, as well as the key basic platform for promoting national scientific research and technological progress. However, it has not well met the needs of users and information services, which makes users in the "information ocean" fall into the dilemma of "lack of knowledge". How to provide more information effectively is an important topic faced by digital libraries. The University of North Carolina's digital library is one of the first to provide personalized libraries, it was established in the beginning, customer-facing, customizable and other functions together, and with high-tech, intelligent library environment and facilities, improve the overall image of the campus, enhance the pride of faculty and students, and lead their new discoveries [1]. Stanford's digital library Fab realizes the effective processing of data on the network through content recommendation, collaborative filtering and other technologies on a large amount of data on the network. The "Guide Accompanying" project of the University of Arizona enables readers to customize the system according to their own needs through interactive online guidance, and at the same time, it can be expanded and improved to increase the utilization rate of digital libraries. The University of North Carolina library in 2010 launched a new Wolf Walk, this new Wolf Walk can according to the students' GPS location and the school's electronic map, see some of the school's famous scenery pictures and related anecdotes, but also use mobile phones to interact with students. Smart Libray is a new type of library at the University of Oulu in Finland. It can automatically recommend books to readers according to their specific circumstances [2]. The public library in Orange County, California, uses "proximity sensing" technology to automatically recommend the materials it needs to readers, thus achieving personalized reading. Bedpiece believed that the central feature of a library was how it could adapt its services to the changing circumstances of its users. In the face of the rapid development of information and communication technology, librarians should reflect on their position and motivation [3]. The service requirements of readers are developing towards the trend of intelligence, individuation and integration. Although there have been some new developments in the information service of digital library, the relevant research at home and abroad has not reached the

goal of "information search". With the continuous development of ontology, knowledge base construction, user modeling, social network analysis, self-adaptation and other technologies, new opportunities are provided for this research. Therefore, this paper constructs the architecture of user-based adaptive information service of digital library. Through the analysis of user behavior and knowledge background, it can find, discover and dig out the optimal user dynamic demand pattern and manage it intelligently, so as to achieve the purpose of user adaptability. It can meet the user's efficient, dynamic and intelligent application requirements.

## 2. Intelligent Library System based on Knowledge Base

### 2.1 System Structure

Due to the existence of self-organization factors, the knowledge ecosystem develops towards a dynamic, open, organic and complex system. Moreover, the flow characteristics of knowledge individuals or communities in the system will also be affected by the orderly organization level of the system. Therefore, driven by self-organizing factors, the system needs to follow some basic principles and operate according to some rules [4]. It can automatically adjust the processing methods, constraints, processing parameters, etc., and adjust the characteristic data generated in the process of cooperation and competition between knowledge individuals or communities. The relationship between the knowledge ecosystem and the knowledge ecological data it deals with eventually forms a new and stable state, so that its external statistical distribution characteristics match its own structural characteristics, and finally get a better knowledge service effect. The knowledge ecosystem model based on intelligent library is composed of five parts, which are platform ecological module, knowledge ecological module, environment ecological module, service ecological module and ecological core component. When each ecological module can fulfill its own functions, it also has the characteristics of interaction between each ecological module, and they can use synergies to realize the ecological process of knowledge individuals and communities involved in knowledge services (Figure 1 is quoted in Land 2021, 10(2), 131).

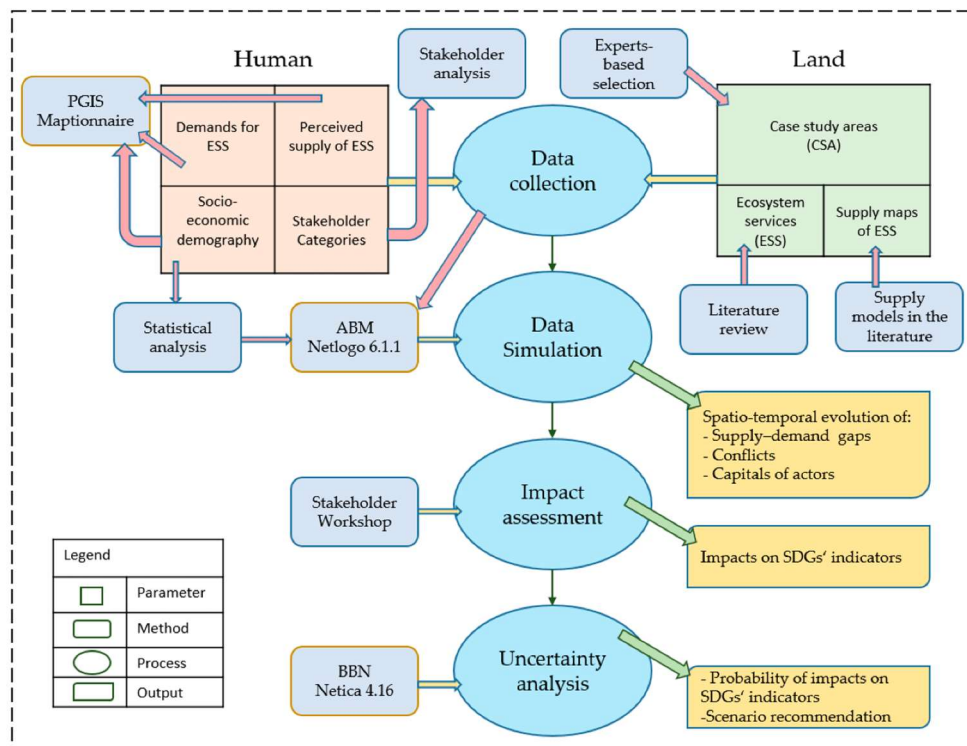
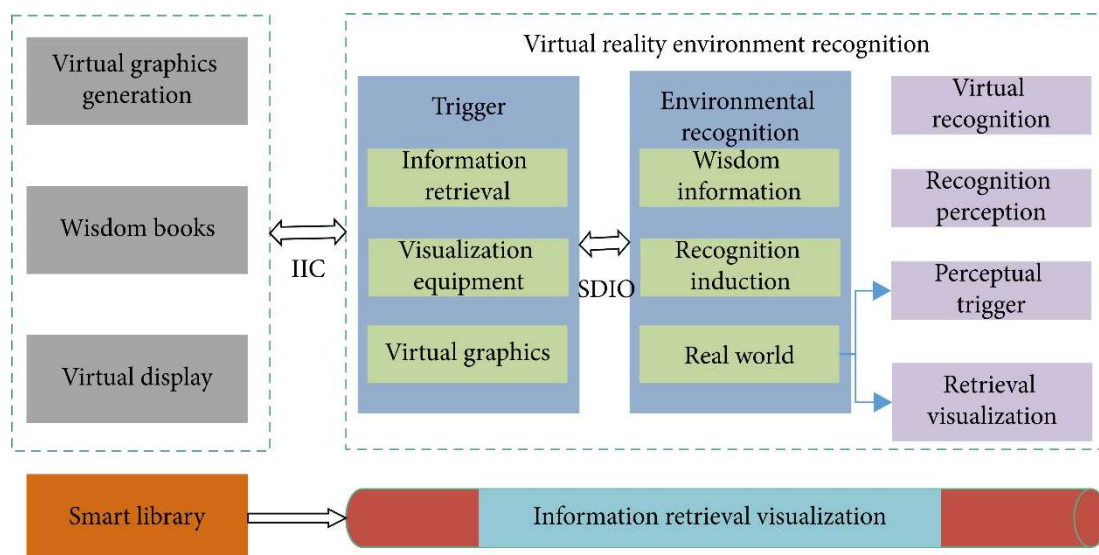


Figure 1. Knowledge ecosystem model of smart library

In the establishment of the theme structure module of the service system, the hardware system platform, knowledge service system, service management system, load balancing system, security control system, etc. are used to achieve the low-level support for high-level knowledge service functions. Through the interaction of the three links of "service, resource and evaluation", the service model of "reader, system and library" is established [5]. The elements of service, information, space, policy, technology and operating environment are integrated to achieve the purpose of optimizing and improving the quality of ecological environment. Through the metadata mining, analysis, sorting and clustering, the ecological improvement of knowledge community is realized. By using the big data analysis and accurate calculation of user data, the user portrait library and scene library are established, and the needs of users are deeply mined and recognized, and the library resources are combined to establish an innovative knowledge base. A service ecology supporting knowledge service innovation and diversification of intelligent library is established, and the core of knowledge ecosystem with service, resources, system evaluation, decision pushing and management is driven to promote knowledge organization and knowledge reengineering based on platform ecology, knowledge ecology and environment ecology constructed by ecosystem model.

### 2.2 Data Mining based on Knowledge Base

The knowledge ecosystem of smart library combines machine learning, multiple data mining, data crawler and other technologies, obtains a large number of academic literature metadata knowledge resources from open access journal databases, academic search engines, etc., and uses artificial intelligence decision trees, artificial neural networks, natural language processing and other technologies to discover hidden rules [6]. Then, multi-layer structural modules in the knowledge ecosystem are used to extract and cluster knowledge individuals. And autonomously discover knowledge service content that matches specific reader needs (Figure 2 is referenced from Visualization of Information Retrieval in Smart Library Based on Virtual Reality Technology).



**Figure 2.** Data flow of knowledge service in smart library

Through the use of distributed system service module, to realize the orderly organization of knowledge, so as to establish the association between cross-type knowledge resources, and according to the specified specification to arrange these resources, so as to facilitate the data organization and data processing. In the module at this level, in addition to the expression of knowledge, it is also necessary to cluster and sort out the knowledge and hot information needed to provide knowledge services to readers based on the standards of knowledge innovation and reconstruction, and select appropriate coding methods based on the differences of different types of knowledge individuals and community organization structures [7]. Then, based on individual identification, data collection, data

processing and other levels, a multi-level knowledge granularity is constructed to complete the machine learning process, which not only facilitates the machine to understand the knowledge metadata set based on mining and processing, but also facilitates the user to understand and interact with its information. The knowledge representation mechanism based on the hardware support system of knowledge ecosystem is adopted to reflect the relationship between different knowledge through semantic annotation, process representation, frame method, etc., so as to form the basic knowledge structure that can be read and processed by computers. Then, the user's knowledge service requirements are classified, knowledge elements are extracted and used as the smallest knowledge expression unit, and the described knowledge is arranged in an orderly manner, so that they can be better used, disseminated and shared in the process of knowledge base construction and knowledge mining.

### 2.3 System Running Process

The knowledge service mechanism is analyzed according to elements and dynamics based on the theory of system dynamics. Finally, the operation mechanism model of the knowledge service ecosystem of intelligent library is constructed (Figure 3 is quoted in Data 2022, 7(1), 7):

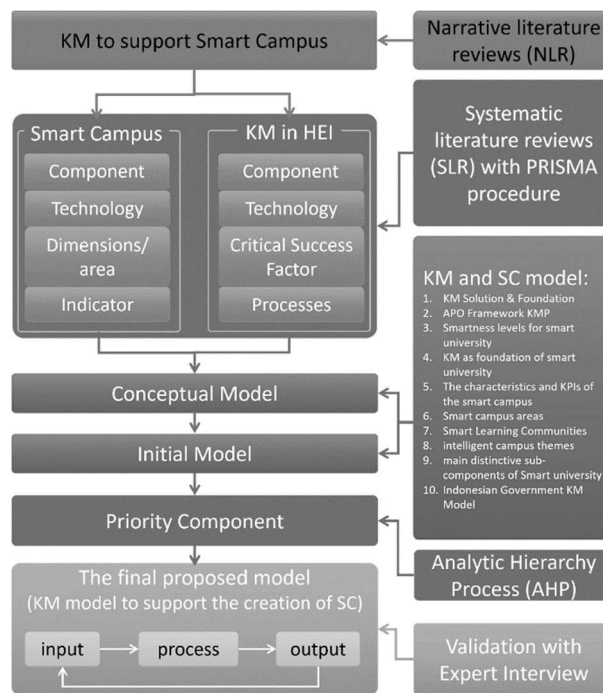


Figure 3. Operation mechanism model of knowledge service ecosystem of smart library

The relevant factors in the knowledge service ecosystem of intelligent library can provide support for the construction of knowledge service, and can provide knowledge service according to the needs of receivers, and its service power will also have a great impact on knowledge service. Each factor is to complete the "people-platform-people" interaction, providing information, material, technology, environment and other multi-level support. In the production, processing, dissemination and consumption of knowledge, the user's desire to use knowledge is stimulated [8]. The knowledge service ecosystem of intelligent library shows the characteristics of self-growth, stability and balance, and is based on the mutual combination and interactive influence of internal and external power. In order to realize its evolution and promotion, it must be realized through the matching and coordination of internal and external power. The endogenous driving force of the knowledge service ecosystem of intelligent library includes the endogenous driving force and hindrance force closely related to knowledge service, which is a kind of endogenous and sustainable use behavior perception for the receiver and subject of knowledge service. With user as the core, endogenous motivation is divided

into the following contents: knowledge demand driving force, service platform perceived ease of use, perceived usefulness, perceived incentive driving force, service behavior usability, usefulness, perceived incentive, etc. The above three factors constitute potential endogenous variables, which have a certain impact on the customer service behavior of enterprises. The external driving force of knowledge service in intelligent library refers to the driving force of knowledge service system formed under the action of external forces. Its types include information power, user power, information technology power, information environment power and so on. It corresponds to the four elements of the supply side of the library, emphasizing basic resources, talents, technology and space. This paper establishes the information technology system of intelligent library based on information technology, and makes deep research on it.

## 2.4 Knowledge Base Design

Word segmentation, part of speech marking and entity recognition of book materials are realized by using text preprocessing technology, and the text materials are preliminarily extracted. Despite the preliminary data analysis, the data contains many elements such as words, phrases and sentences, so the corresponding conceptual features must be extracted from the data. In this paper, a new concept classification method based on semantics is proposed [9]. The research of semantics focuses on the analysis of the relationship between concepts and semantic similarity. The use of synonyms and synonyms dictionary to expand the meaning of the meaning; By identifying the semantic ambiguity and eliminating the semantic conflict, the semantic synthesis is finally realized. Ontological tools are used to formalize the results of these semantic synthesis, and semantic reasoning techniques are used to mine the information. Finally, a semantic Library of library resources is constructed (Figure 4 cited in Intelligent Library Service and Management Based on IoT Assistance and Text Recommendation).

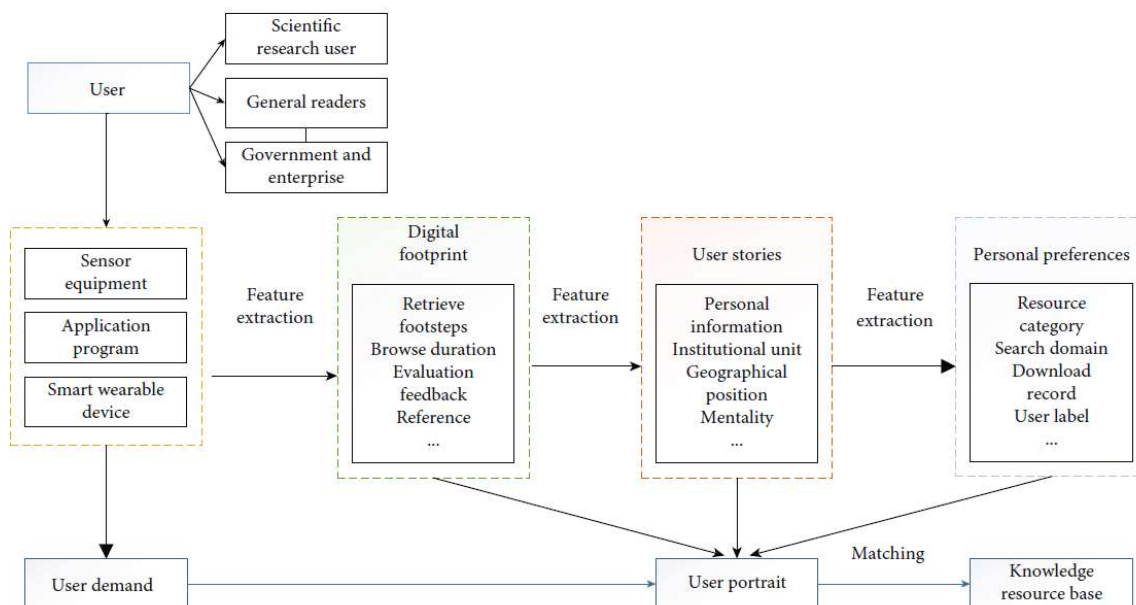


Figure 4. Digital library knowledge base model

The user's message behavior is studied and the preference characteristics of the message are extracted, thus the system of the message system is formed. Through the analysis of information browsing content, information retrieval keywords and user knowledge background, the user's interest text is established, and the text segmentation, feature extraction and classification are carried out on it. Finally, the domain ontology is aligned to establish the user's knowledge ontology. Through the analysis of social networks, the user's social situation is analyzed to obtain the corresponding user's preference ontology, and it is integrated with the user's knowledge ontology and behavior ontology

to build the user's preference database, and the user's preference database is built based on the behavior ontology and knowledge ontology. Classify the user's information resources, identify their characteristics, establish the user's information requirements, build the user's knowledge map, build the user's information needs database.

### **3. System Implementation**

#### **3.1 Information User Layer**

In the Web3.0 era, due to the diversified identity changes of information users, their types have been extended from simple receiving users to receiving users, construction users and receiving - construction double heavy 3. In the process of library mobile cultural services, the receptive mobile information users can only be information users, who can choose the form of service modules through various types of services provided by the library to receive the resources of library mobile cultural services. Construction-oriented mobile information users, more in the identity of information resource builders, use the service platform to link the service modules to realize the construction of matching cultural information resources. The dual-load mobile phone information users have both the above two characteristics, while completing the acceptance and related construction of cultural information resources.

#### **3.2 Service Platform layer**

According to the types and characteristics of the cultural knowledge resources to be pushed and the demand for their acceptance, the library can make appropriate selection of various information transmission channels. According to the classification of the level of control over information users' compulsory reading, it can be found that the compulsory reading ability of SMS is the strongest, so important cultural knowledge resources that are highly required by information users and customized by information users can be transmitted through SMS channels. The advantage of 5G is that it can process image, music, video and other media, and can provide users with various information services such as web browsing, teleconferencing, e-commerce and so on. It can transmit cultural knowledge with rich media forms and massive data through this platform. WAP is a wireless application protocol, it makes the mobile Internet has a universal standard, it brings a lot of information and advanced services on the network to the mobile phone and other wireless terminals, so that you can choose the cultural knowledge resources that are long in content and need to read for a long time.

#### **3.3 Service Module layer**

In the design of library mobile cultural service module, according to the categories of mobile information users, it mainly establishes three modules: public push module, user customization module and user participation co-construction module. Among them, the "public push" module will face all kinds of information users and provide them with an undifferentiated recommendation service for general cultural knowledge. Its recommended cultural content knowledge amount is relatively small, and the depth of knowledge is relatively shallow. The purpose of the "user customization" module is to serve information users with a high degree of individualized cultural needs. Information users can either customize according to the customized catalog provided by the library, or negotiate with the library to achieve complete personalized customization. Because a customized business requires operating expenses, there is usually a service charge. Information users can complete the transformation from the role of users to the role of builders, and can upload the cultural knowledge resources that they think are valuable to a specific database, so as to achieve the purpose of resource sharing with other information users. Prior to open sharing, it must be reviewed and checked by the creator of the library information materials.

### **4. Conclusion**

Through the use of ontology technology, knowledge graph, situational awareness and other technologies and means, the user's information needs are tracked, and the dynamic matching between

information needs and information services is realized. With the methodology of software engineering, the sustainable information service is provided to users.

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