

# Virtual storage technology and its application in digital library

DAI CHUANKUN<sup>1,3</sup>, ZHANG NAN<sup>2</sup>

**Abstract.** The digital library technology based on virtual storage technology has brought great impetus to higher education and the improvement of students' comprehensive quality. In order to better promote the perfection of the virtual storage technology of digital libraries in China, in this paper, on the basis of understanding the relevant theories, the configuration of the server of the virtual storage technology of the digital library was further analyzed. Then the quantitative analysis was conducted to determine the advantages of digital library development. Finally, the performance of the virtual storage system of the digital library was tested. Test results show that the system has stronger compression capacity, and compared with the traditional library, it has the advantages of large amount of resources and high sharing ability, and thus can promote the further improvement of the mode of higher education in China. The study provides theoretical support for the establishment of digital libraries in universities and colleges, and provides reference for the development of higher education in China.

**Key words.** Virtual storage technology, digitization, library.

## 1. Introduction

With the development of the times, the world economy level is improving rapidly, and people's demand for knowledge is gradually increasing too, especially in the current era of rapid development of various industries, the role of knowledge is extremely important. As for the important link of knowledge popularization, the establishment of the library has brought positive effects to the popularization of knowledge. As knowledge continues to improve, more libraries are beginning to build up in the world, and the collection of books in each library is also increasing. Many colleges and universities have begun to establish different ways of libraries, and which has brought a certain degree of positive impact to the students' learning. The mass establishment of libraries is essential to the continuous improvement of the overall

---

<sup>1</sup>Dongfang College, Shandong University of Finance and Economics, Taian, Shandong, 271000, China

<sup>2</sup>Shandong Sport University, Jinan, Shandong, 250102, China

<sup>3</sup>Corresponding author

knowledge level of the world, and each industry needs more comprehensive talents with the development of the times. In this trend, many colleges and universities begin to pay attention to the promotion of students' comprehensive abilities. Relying solely on classroom education may not improve students' overall level of achievement better. In the spare life, students should have more learning resources, which can further provide a supporting role for the promotion of self-level. And nowadays, the demand for the size and the amount of paper resources has also gradually increased in traditional libraries. Under this trend, the concept of digital library has been put forward and further applied to the construction of actual data resource information, so as to provide certain scientific supports and references for the reserve of world's knowledge.

## 2. State of the art

With the development of the times, the education industry has become an important guarantee for economic development. It can train the related personnel and further provide a certain amount of information resources for the promotion of the comprehensive-level talents [1]. In many schools, the establishment of libraries has gradually become one of the evaluation indicators of the comprehensive level of colleges and universities. As an important center for documentation and information in the construction of universities, libraries provide certain services for the promotion of students' academic levels. However, with the development of education industries, the increasing number of colleges and universities and the increasing enrollments, the demand for library construction and collection is also increasing [2]. This indirectly leads to the tension of some land resources. In order to better meet the needs of the volume of books, many colleges and universities have begun to increase the purchase rate of books, which has brought a great impact on the demand for paper resources. Under this trend, the concept of digital library has been mentioned. Because of the better use of computer technology in the current era, the establishment of libraries relies more on certain electronic information platforms to complete the transmission and supply of relevant data and information. At the same time, as a new additional form of traditional library, digital library has more data resources and is more shared, and it will not cause environmental damage and waste of resources [3]. As a resourceful expression form under the new era, the library in this model is more individualized and more extensive, and it can provide more resources for the demanders more efficiently and quickly. Therefore, it has gradually been paid more attention by scholars and researchers, and its related theories have constantly improved and summarized.

## 3. Methodology

With the development of the times, the world has gradually taken the economy as one of the important subjects of the development of the times. The rapid development of the economic level has brought certain impetuses and positive influences

on the development of various industries in the world. Especially the comprehensive level of the industries is rising, at the same time, the requirements of industries are also rising, and the needs for continuous screening of related human resources provide certain internal impetuses to the development of the industries [4]. The improvement of the overall and comprehensive level of the world industry also requires more high-quality talents to enter the process of enterprise development, which makes the training of talents gradually become an important direction of the development of the times. Since the reform and opening policy of China, the economic level has been greatly improved and developed. Meanwhile, the development of all sectors of our country has further promoted the development of education [5]. China's higher education has gradually reached the world advanced level, and the investment in the education industry has gradually increased, so the development of education has become one of the most important subjects in the development of the times. The development of education is of great significance to the promotion of China's comprehensive strength. More and more talents have been trained for all sectors of our country, and the process of personnel training in China has become more perfect and scientific with the continuous improvement of educational resources, and the quality of the employed population has also been continuously improved [6]. However, it is not enough to rely on the knowledge transfer process of the classroom teachers to realize the comprehensive development of the students, and students in the spare time also need to further understand other knowledge through relevant resources. And in the process of learning, if there are relatively difficult problems, students should not only communicate with the teacher, but also need to do their own work to refer to the relevant point of view. Only in this way, the theoretical support and scientific basis can be further provided for the improvement of students' comprehensive level and ability. In this trend, in the establishment of colleges and universities, China has also invested a large degree of funding for the establishment of various university libraries (see Fig. 1). The increasing number of libraries and the increasing volume of books make it possible for students to have more resource information, so that they can learn more knowledge, better enrich themselves and improve their comprehensive qualities [7]. However, with the emergence of more colleges and universities, the increasing number of students and the increasing desire for knowledge, all these problems directly or indirectly bring pressures to the traditional libraries. At the early days of the construction of a lot of libraries, the construction area may not meet the current number of people. According to statistics, with the increasing number of readers in our country, many libraries in many areas or colleges have been unable to meet the actual number of books, which has caused that some people have study problems. What's more, the books in the libraries are mostly paper books, and people may cause damage to books after a long time of reading, which causes certain limitations to the dissemination of relevant knowledge; and the use of a large number of books has a certain impact on paper resources, because more and more trees are cut down and used to make paper, thus affecting the sustainable development of the ecological environment [8]. Therefore, in conclusion, our current traditional library model may no longer be able to better meet the desire for better solutions, and the application of a large number of books may also lead to

an increase in the use of paper, the size of the library and so on. Under this trend, our country urgently needs a new library construction mode and applies it in the current education industry, so the introduction and development of related concepts of digital library provide a certain way for solving this uncoordinated phenomenon in our country [9]. Therefore, in this paper, the construction of digital libraries and the application of related virtual storage technologies were paid much attention to, so as to provide some scientific supports for the improvement of related theories and techniques in China.



Fig. 1. Development of university libraries

First of all, the circulation of library books from 2010 to 2014 in some colleges and universities in Nanjing (A, B, C, D and E) was analyzed in this study. The analysis results are shown in Fig. 2.

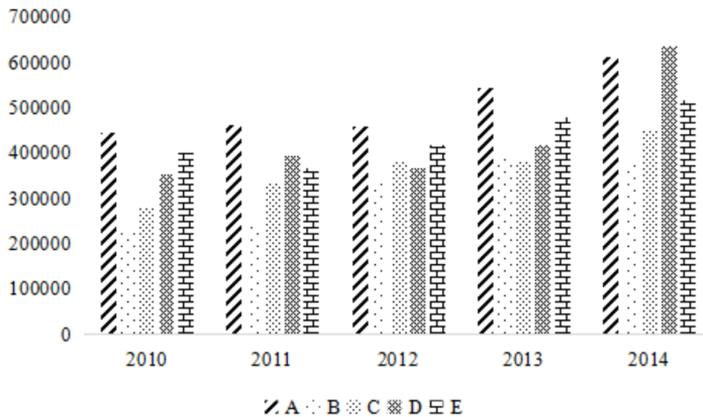


Fig. 2. Overview of data circulations in five colleges and universities in Nanjing

The data circulation of the five university libraries in Nanjing was summarized in this paper. It is further found that with the development of the time, books in

libraries show a trend of increasing year by year, and it shows that China's traditional libraries are facing greater pressures. Therefore, it is necessary to set up a digital library to alleviate the related pressures.

Then, through the analysis of relevant data, the virtualization technologies of academic libraries in our country and the related theories and concepts were determined for analysis, and the related configurations of the hardware facilities used in the digital library were summarized.

On the basis of a clearer theory, the pressure capacity of the virtual storage technology of the digital library of the university was further analyzed in the paper through the Benchmark Factory Software, so as to provide the data reference for the later development of the virtual storage technology [10].

Finally, the advantages of virtual storage technology for digital libraries in China were further analyzed in this study by means of questionnaires, so as to further provide theoretical basis for the further development of digital libraries in universities. Information about the investigator is shown in Table 1.

Table 1. Overview of personnel information used in this questionnaire

Investigator	Number of people	Average age	Proportion of men and women
College students	20	24.71	3:2
University teachers	20	35.11	1:1
Librarians	10	37.24	1:1

#### 4. Result analysis and discussion

With the development of the times, China's education industry has been greatly improved. In this trend, China's traditional libraries are also facing great pressures, and China needs large land areas to achieve the construction of the library. And with the increasing demand, our lands and paper resources have been under certain pressures. Since the introduction of the theory and technology of digital libraries, our country has begun to use this technology extensively, and it has further promoted the pressure relief of traditional libraries. As one of the main forms of combination of traditional libraries and information technologies, digital library is the current trend of development, which combines the advantages of information technology, resource, information and sharing with the traditional library, so it brings a great deal of practical significance for the mass dissemination of book resources. As for the concept of digital library, it is not only to display some traditional paper data resources in digital forms to those who need it, but also to provide a certain type of services for all demanders as a carrier [11]. For the concept of digital libraries (Fig. 3), many researchers believe that the new library model should serve as a service system which integrates all of the more dispersed data resources.

This system can not only display all the knowledge and theory to readers and provide more information for readers as the traditional library model, but also pro-



Fig. 3. Development of digital libraries

vide the relevant theoretical research process for readers, so as that the readers can further understand the relevant theory of the origin and development of the whole link from the source. Therefore, in general, the digital library not only has the storage link of the traditional library for the relevant data information, but also includes the sharing and processing of all the data information [12]. As an important way to share and transfer data resources in the current era, digital library has mainly undergone the emergence of related theories and techniques, the continuous improvement and development of theories and technologies, and the application of relevant theories. Among them, the emergence of the related theories and technologies is mainly in the premises that the demand for data resources is increasing in the current era, and the establishment of a large number of libraries has created some damage to the space and other resources of people's living environment, people begin to put forward the combination of information technology and the traditional library construction mode which develops rapidly in the current era, so as to achieve more sharing of resources. The development of data information technology has positive influences on the theory and technology of the digital library. More data resources are displayed on a certain platforms because of the development of data and information technology, and the use of more innovative information technologies can effectively achieve the sharing and transmission of data information, thereby reducing the waste of related resources. Therefore, many scholars have combined this kind of digital technology with the construction idea of data library, so as to lay the foundation for the development of other researches [13]. On the basis of relevant theories, many scholars have begun to consider how to store large amounts of data resources. Only by further improving the storage efficiency can some technical supports be provided for the further improvement and development of digital libraries. Nowadays, the rapid development of computer technology has brought some impetuses to the development of information storage technologies in digital libraries, especially with the development of the virtual technology, more and more data storage theories have been combined with the virtual storage technology, so that the new virtual storage technology has been developed, so as to provide influences for related resources of

the subsequent library [14]. Many researches have already considered that virtual storage technology is one of the most important parts of digital library developments. Only by doing better analysis and researches of this link can some theoretical and technical supports be provided for the improvement of digital library [15]. In this study, based on the further reading and summarizing of the relevant data, the host configuration of the main digital virtual storage technology used in a university in our country was summarized. The results are shown in Table 2.

Table 2. Virtual storage configurations of digital libraries in a university in China

Device name	Brand	Model	Parameter	Quantity (unit)
The server	DELL	PowerEdge R710	2U chassis CPU: one Xeon 5606 memory 16G, 3X146G SAS hard disk-RAID5, double redundancy power supply, HBA slot. CD driver.	3
Optical fiber storage (HBA)	DELL			3
Storage /IP/SAN	DELL	MD3200i	24T, 24*1TSATA	2
UPS	Emerson	NXR-40KVA	2 hours	1
Cabinet	Totems	AD.6937	37U	1
KVM	Tanto	XL-1708	8 rims, with display and keyboard operation	1

Then, the Benchmark Factory software was used to test the running pressure of the virtual storage system of a digital library in a university. The results are shown in Table 3. The results show that the system has experienced all the test items and there are no crashes and snaps. Therefore, it can be considered that the virtual storage system has a strong ability to resist compression.

Table 3. Test result analysis of related indicators of Benchmark Factory software

User load	TPS	Average response time (s)	Total executions	Total rows	Total errors
10	0.564	0.569	98	541	0
50	2.669	0.098	483	2638	0
100	5.295	0.159	946	5183	0

Through the questionnaire, the advantages of the virtual storage technology for digital libraries in our country were analyzed in this paper. The results are shown

in Fig. 4. The results show that compared with the traditional libraries, the digital library based on virtual storage technology has more resources and more sharing. Therefore, the digital library based on the virtual storage technology is more suitable for the development of higher education in our country. And through the questionnaire survey, it can be found that more people believe that our country should apply the related theories and techniques of digital library to the actual construction of university libraries, and the results are shown in Fig. 5.

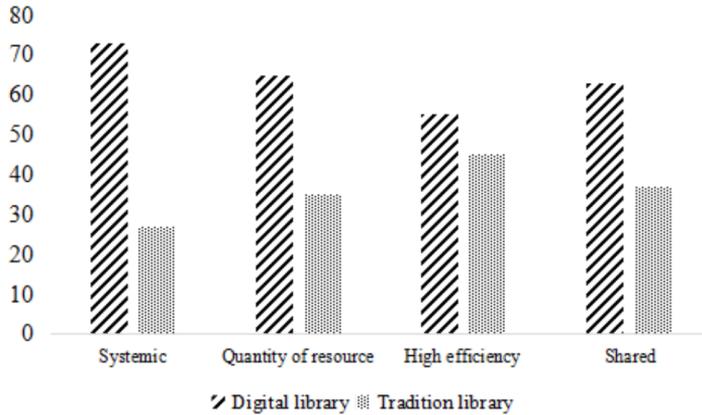


Fig. 4. Comparative analysis of digital libraries and traditional libraries

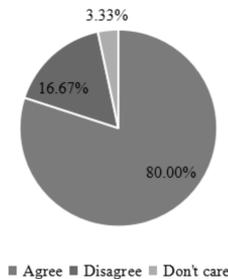


Fig. 5. Researches on the acceptance of digital libraries based on the virtual storage technology in Chinese universities

### 5. Conclusion

With the development of the times, the economic level of the present era has been greatly improved. In this trend, all industries in the world have been developed to a great extent. And the development of various industries has also begun to have more demands for high-quality talents, which has made the education industry in colleges and universities obtain great development. For the development of higher education,

it is very important for libraries to study and perfect the relevant knowledge for students. Relevant theories were clarified in this study by reading relevant data, so that the relevant theories were cleared; and then the configuration of the server of the virtual storage technology was analyzed. Through the questionnaire, the digital library has higher advantages, which is very necessary for the development of education in China. The research results show that this kind of technology is very necessary for the development of higher education in our country. The purpose of the research is to provide theoretical basis and reference for the development of the digital library technology in China. This research still has some shortcomings for the discussion and comparison of virtual storage devices, but it can still be used as a reference for related researches, and can provide some data supports for the development of the digital library.

## References

- [1] D. X. LU, Y. X. NIU, L. Q. ZOU: *Analysis of virtual storage technology and its application in the library*. *Advanced Materials Research* 756–759 (2013), 1289–1294.
- [2] X. W. KANG, Y. J. YANG, X. DU: *Application of virtual storage technology in disaster tolerant system*. *Computer Engineering* (2009), No. 21, 36–38,41.
- [3] X. Y. ZHOU, Z. H. HU, J. K. SHUN: *Security architecture of digital library research in general knowledge environment*. *Applied Mechanics and Materials* 198–199 (2012), 601–605.
- [4] T. KIRCHHOFF, W. SCHWEIBENZ, J. SIEGLERSCHMIDT: *Archives, libraries, museums and the spell of ubiquitous knowledge*. *Archival Science* 8 (2008), No. 4, 251–266.
- [5] W. YANG: *Embedded discipline-oriented service: The new idea on transformation and development of research University Libraries*. *Information and Documentation Services* 33 (2012), No. 2, 88–92.
- [6] F. W. J. VOGES: *Sustainable development and the socially embedded firm. An inquiry into the nature, causes and transformation of structural unsustainability in contemporary liberal capitalisms*. Dissertation, University of Stellenbosch, South Africa (1999).
- [7] J. XIE, L. SUN: *Macaudata.com: A shared virtual library and digitization project*. *Journal of Interlibrary Loan, Document Delivery and Electronic Reserve* 23 (2013), Nos. 4–5, 179–190.
- [8] E. HENTHORNE: *Digitization and the creation of virtual libraries: The princeton university image card catalog—reaping the benefits of imaging*. *Information Technology and Libraries* 14 (1995), No. 1, 38–40.
- [9] M. SULLIVAN, M. N. OCHOA: *Digital library of the caribbean: A user-centric model for technology development in collaborative digitization projects*. *OCLC Systems & Services*, Emerald Group Publishing Limited 25 (2009), No. 4, 249–262.
- [10] F. BETTIO, A. J. VILLANUEVA, E. MERELLA, F. MARTON, E. GOBBETTI, R. PINTUS: *Mont'e scan: Effective shape and color digitization of cluttered 3D artworks*. *ACM Journal on Computing and Cultural Heritage* 8 (2014), No. 1, 4–22.
- [11] J. FENG, N. X. ZHAO: *A new role of Chinese academic librarians-The development of embedded patent information services at Nanjing Technology University Library, China*. *The Journal of Academic Librarianship* 41 (2015), No. 3, 292–300.
- [12] L. ZHANG: *Discussion on subject knowledge service pattern of Agricultural University Libraries*. *Journal of Computer & Communications* 4 (2016), No. 1, 33–38.
- [13] Q. H. WENG, D. S. LU: *A sub-pixel analysis of urbanization effect on land surface temperature and its interplay with impervious surface and vegetation coverage in Indianapolis, United States*. *International Journal of Applied Earth Observation and Geoinformation* 10 (2008), No. 1, 68–83.

- [14] Y. XIONG, S. HUANG, F. CHEN, H. FE, C. WANG, C. ZHU: *The impacts of rapid urbanization on the thermal environment: A remote sensing study of Guangzhou, South China*. *Remote Sensing 4* (2012), No. 7, 2033–2056.
- [15] B. YANG, J. LI, Q. ZHANG: *G language based design of virtual experiment platform for communication with measurement and control*. *Procedia Engineering 29* (2012), 1549–1553.

Received July 12, 2017