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"Multi-screen in One" System Design of Education Video Oriented U-learning

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Abstract

On the research of the transcoding and the adaptive distribution and scheduling of education video with multi-platform compatibility, this paper proposes the overall technological solution of "multi-screen in one" technology oriented ubiquitous learning (U-learning) on the education video, realizing the seamless joint of education video between different screens so as to ensure the continuous learning, and achieving the intelligent recommendation of relevant video resource. Supported by the key technology of "multi-screen in one", the multimedia asset management system and personalized video resource recommendation system are established and applied to Shanghai Lifelong Learning Network. Higher requirements such as video resource storage, transmission and retrieval in the U-learning environment can be satisfied by the multimedia asset management system, thus making the learners acquire the video resources which are compatible with the network and facilities automatically. Meanwhile, personalized video resource recommendation system is able to provide different customers with specific learning resources, and also gives better support for their personalized learning.

Keywords: Multi-screen in one, U-learning, personalized recommendation, multimedia asset management, transcoding, Educational video

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1. Introduction

With the rapid development of information technology, our learning is no longer limited in traditional classroom, but has further extension in time and space. The idea of learning with any devices, anytime, and anywhere has been accepted by more and more people. With the integration of telecom, radio, TV, and Internet networks [1], multi-screen has obvious advantages in terms of: large capacity, diversification, interaction, sharing, terminal diversity, storage, and cost compared to the traditional single-screen approach to learning

In the flood of U-learning resources, education video resources account for a very large proportion. However, there are still some problems in the application of video resources. For example, there is insufficient support in the switch, adaptive distribution, and scheduling of video resources between different devices; the search results cannot meet the precise requirements of users; education video resources can only be used in separate devices, and cannot realize the seamless and continuous learning between different devices.

With the coming of the "Tri-networks integration, Multi-screen in one" era, multi-screen in one technology provides us a good solution to achieve continuous learning based on seamless migration between different devices. To solve the above problems, this paper presents a technological solution of "multi-screen in one" technology oriented U-learning on the education video. Researches were conducted inthe transcoding and the adaptive distribution and scheduling of education video withmulti-platforms compatibility and realize the seamless joint of education video between different screens so as to ensure the continuous learning and achieve the intelligent recommendation of relevant video resources [2].

For these reasons, this paper has an important theoretical and practical significance in the U-learning environment. Combining with the U-learning model, this paper primarily presents the system structure of "multi-screen in one" and the necessary support of key technologies, which is known as key technology of the back-end support and key technology of the front-end support. Based on the key

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technologies, the "multi-screen in one" system of education video oriented U-learning is established, namely, the multimedia asset management system and personalized video recommendation system. Currently, the technologies

have been applied to Shanghai Lifelong Learning Network. This practical application reflects support of the "multi-screen in one" technologyfor continuous learning in U-learning environment.

2. Continuous blended learning model in U-learning environment

The concept of "multi-screen in one" was generated in the context of tri-networks integration. It provides support for the realization of U-learning. U-learning integrates the strengths of E-learning and M-learning [3], and it has some characteristics: permanency, accessibility, immediacy, interactivity, situating of instructional activities, and adaptability [4]. U-learning environment covers the real world and virtual space connection, and forms continuous blended learning model on the basis of tri-networks integration. It should be developed with both an understanding of human learning in general, and the learning of formally structured knowledge through de-structured u-learning environments .[5,6]

Continuous blended learning model is to learn by using a variety of devices on the environment constructed by multi-screen in one technology. In this model, when learners switch the learning terminals, they can also take continuous learning for the same learning content, or they can continue the same learning activities. Continuous blended learning model focuses on integrating the advantages of different learning terminals. It could present learning resources and learning strategies to learners on an appropriate form in different terminals, which makes learners getting learning resources continuously in working environment, even in mobile space and other informal learning space, seamless learning transfer is achieved.

Compared with previous learning models based on digital terminal and information network (such as e-learning, mobile learning, TV learning, etc.), continuous blended learning model not only inherits the characteristics of the original models, but also adds new elements to form its own unique characteristics: the continuity of learning environment, learning content, learning support service, learning interaction, learning management, and learning evaluation. In summary, in the environment of multi-screen in one, the continuous blended learning model emphasizes the characteristic of continuity which reflects the connection of each element besides the characteristics of existing learning model based on computer network,

Human learning activities can be divided into formal and informal learning. Formal learning is the learning activities which aim to a specific target. Informal learning has no fixed place and learning content. The biggest difference between formal learning and informal learning is that formal learning is initiated, and organized by the external factors, while informal learning is self-initiated, self-control, and self-responsible by the learners. Therefore, the knowledge from informal learning associates more with actual needs, and the tacit knowledge is easier to keep. Continuous blended learning model is shown in figure1. U-learning environment combines formal learning with informal learning to maximize learning. Learning model forms in the cross-latitudes of formal-informal and individual - collaboration. Continuous blended learning model includes the individual-formal learning, such as distance learning, inquiry learning, creative learning, sharing, and reflective learning, collaboration-formal learning, which contains

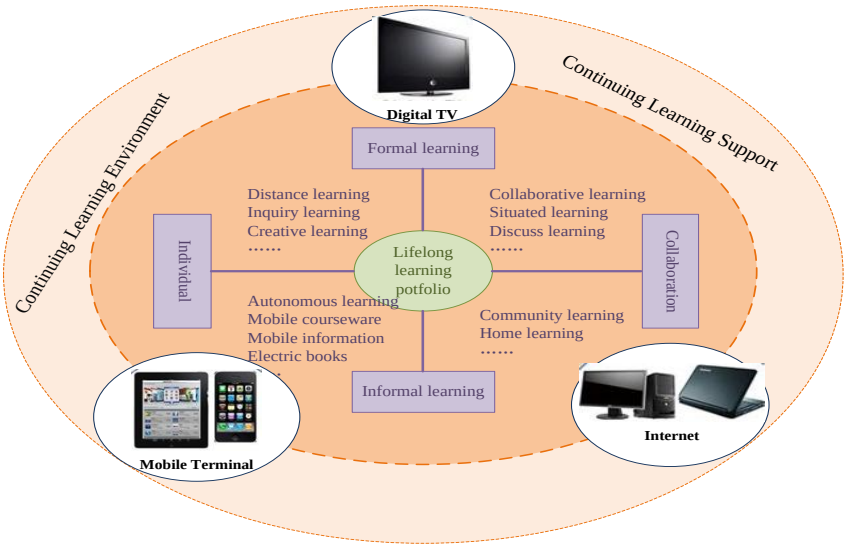

Figure1. Continuous blended learning model

collaborative learning, contextual learning, discussion learning, etc. It also includes the individual-informal learning, such as autonomous learning, mobile courseware learning, mobile information learning, problem solving, e-books, and so on. And collaboration–informal learning covers the community learning and family learning in continuous learning environment, multi-screen switching can be achieved among different terminals. Learners can choose different learning styles by switching different terminals, and take continuous learning, which meet learners' needs for learning at anytime and anyway to promote lifelong learning [7,8,9].

3. The architecture of the "Multi-screen in one" technology of education video

We have proposed the architecture of the "multi-screen in one" technology of education video on the basis of continuous blended learning, and applied it into Shanghai Lifelong Learning Network. It can solve many problems such as incompatible video formats, data index difficulty, and the lack of learning support service. The architecture is shown in Figure 2.

First, we establish a platform template based on a variety of platforms (including the Internet platform, the mobile platform, the digital television platform and others) at the back-end, and the template realizes the adaptive transcoding based on different platforms and builds a video media resource database. Second, we restructure these transcoded video resources by indexing, and form the resource index database. In addition, the system distributes the transcoded learning resources through the adaptive scheduling list, and sends different video resources into relevant platforms, so that learners can acquire the appropriate video resources, which are compatible with the network and the devices. The back-end system realizes the seamless transmission between different learning terminals and platforms.

In the front-end, after the unified identity authentication based on the E-Portfolio, learners can continuously learn the various resources between different platforms. In the learning process, the system will automatically track and accumulate learners' learning process (such as records of interrupted operations on learning resources), their behavior models, and so on. System will also automatically save all the information into electronic portfolio (E-Portfolio) databases of the remote service. Considering the diverse search needs of learners, the system can recommend relevant learning resources.

The architecture of the "Multi-screen in one" technology of education video can put the continuous blended learning into practice, and also support U-learning service for learners. We can realize the study of learners at any time and any place as well as the unified management and maintenance of the multimedia asset through this architecture. So it is with great advantages to users' experience and convenience.

4. Key technology of the "Multi-screen in one" on education video

In order to achieve the "multi-screen in one" education video architecture, we need some key technological supports. The technological support can be divided into two areas: the back-end support, and the front-end support.

The adaptive video transcoding technology

Video has the characteristics of unstructured data format [10], making it incompatible between different networks, devices

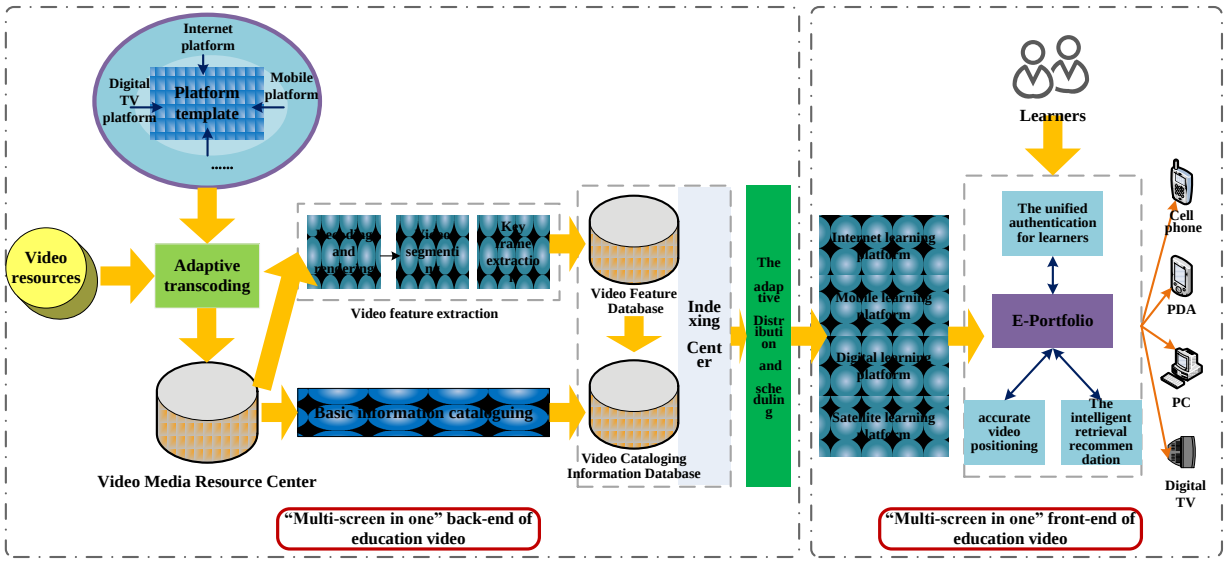

Figure2. The architecture of the "multi-screen in one" technology of education video

and data formats in the process of transmission and access. In response to this problem, the system provides adaptive video format conversion based on different platforms (including the Internet platform, the mobile platform, the digital TV platforms, etc.) through the adaptive video transcoding technology,

The intelligent indexing of video

Compared with the text, pictures, and other information carriers, video has many inadequacies, such as a huge amount of data, the opaque performance contents, and the lack of standards [11]. It causes the process of contents annotation and feature description time-consuming, inaccurate and nonstandard. Based on the intelligent indexing of video, we can realize such functions as video feature extraction and intelligent cataloguing of the video resources, and finally establish the indexing centre for all the video resources [12].

The adaptive distribution and scheduling technology of the video

As the networks and devices under the U-learning environment have characteristics of heterogeneity, the network includes the integration of a variety of network environments-digital television, Internet, mobile networks, satellite, etc. It needs to address the discovery, and adaptive issues of the equipment and network. Through the adaptive technology, learners can access the appropriate network resources.

4.2 Key technology of front-end support

Key technology of the front-end support including three parts: (1) the unified authentication technology for learners (2) accurate video positioning technologies (3) the intelligent retrieval recommendation technique.

The unified authentication technology for learners

Unified authentication can solve such problemsas memorizing multiple passwords to access multiple learning platforms or equipment. The system provides a unified identity authentication, and comprehensive security service, in order to realize the unity of authentication on the Internet, and the mobile platform. The modes are included in the unified authentication technology for learners, that is, the authentication component mode, unified authentication mode, and new proxy mode. Through unified authentication, learners' learning process and records in different platforms can be called between other platforms.

Accurate video positioning technologies

When learners are watching the video, they can add tags, and collect it, as well as save the suspending information into the E-portfolio, and in another platform, they can quickly return to the needed video position, and make accurate positioning. User authentication can also be inherited, which can help to realize the function of continuous learning based multi-screen. This requires that learning portfolios are able to record information in different screens, the records can work in different screens, and all screens have general interface standards, and thus make it possible for data exchanging.

The intelligent retrieval recommendation technique

Facing huge amounts of video resources, in addition to realize full-text retrieval service, we must also focus on the intelligent video recommendation. For all the video, we can record the template by key figures in the picture or key characteristics. When importing pictures, the system can automatically contrast the templates, make records and identifications of those have the character's picture or key features, forming a classification [13].In a retrieval, after the key characteristics (can be key figures) images published online, the system will set the picture transfer to the background video database, and the video centre can directly return the results to the front end, and then recommend it to users.

We also consider the following factors: those resources associated with the contents, the current equipment as well as learners' personal character (hobby information, learners' portfolios (such as learning process, access history). Based on the above information, the system can intelligently recommend more individualized video resources, as Figure 6 shows.

5. The application of the "Multi-screen in one" system of education video

5.1 The construction of Shanghai Lifelong Learning Network

Shanghai Lifelong Learning Network is an important part of digitalized lifelong learning system for Shanghai citizens, which is also a typical learning platform of U-learning on the basis of "multi-screen in one" system of education video. Based on the standardized teaching resource construction, it attempts to construct a personalized teaching and management system for vast learners. Moreover, it is with strong support of network teaching, and owns massive multimedia learning resources, so as to satisfy the learning requirements of numerous Shanghai citizens. In combination with the learning features of different learners, relevant resources recommendation and other learning supports are provided. Shanghai Lifelong Learning Network provides a vast range of high- quality educational resources to learners, including lifelong education, basic education, vocational education, and higher education. The network embodies an integration of multiple functions such as courseware search, learning, exchange, testing, and evaluation. It is a large-scaled online learning platform that can help users

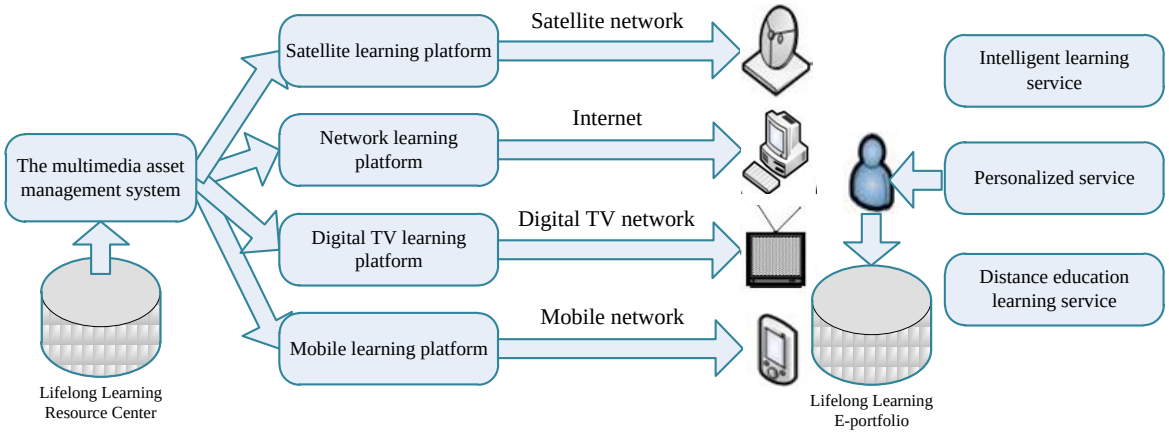

Figure3. Shanghai Lifelong Learning Network platform

effectively learn, investigate, manage, and collect a great variety of information and materials.

The promotion and application of Shanghai Lifelong Learning Network can be seen as a concrete realization of "multi-screen in one" system of education video for U-learning, the platform is shown in figure 3. Shanghai Lifelong Learning Network is constructed in a multi-network environment, which is composed of satellite network, digital television, Internet, and mobile network, it integrated various learning platforms. Learning resources are unified managed through multimedia asset management system, and presented on a variety of learning platforms. Learners can use computers, TVs, mobile phones, and other devices to learn, and get intelligent learning service, personalized service, and distance education learning support service through various channels. The multimedia asset management system and personalized resource recommendation system constructing the network learning platform are typical system models designed and established in accordance with the key technology of "multi-screen in one".

5.2 Multimedia asset management system

The establishment of multimedia asset management system is based on the multi-screen in one back-end support technology. Currently, the multimedia asset management system is applied to Shanghai Lifelong Learning Network. With the development of lifelong learning network industry, a great number of teaching resources are existing in the form of multimedia audios and videos, which gradually transforms from the network audio and video format to high-definition ones. The online multimedia resource capacity of Shanghai Lifelong Learning Network is 14T at present, and there are still numerous multimedia resources without digitalization or automatic management, instead, they are placed on shelves in a traditional and compact shelving way, depending on manual sorting, classification, and cataloguing. The query, retrieval, and obtaining of them are basically dependent on manual work, so there are a lot inconvenience in terms of management, and efficiency. The storage capacity of Shanghai Lifelong Learning Network is with geometrical growth rate, resulting in the non-satisfaction of the current storage management distribution system to the increasing storage management distribution requirements in aspects of capacity, efficiency, and security. Therefore, it is in urgent need to construct a new full-digitalized multimedia asset storage distribution system with massive automatic storage and high transmission speed. How to carry out better management for these massive digital resources along with the conducting of effective retrieval and utilization has become the core content for the multimedia asset management system. So the performance requirements for its storage quality and efficiency, transmission quality, retrieval and query efficiency have been increased.

Universal learning terminals are rich diversity of forms and functions, it also requires universal learning resources can be present in various equipment. In the study of multi-screen in one technology for U-learning, the multimedia asset management system is designed, and implemented by us. Currently, it has formed the formation of multiple functions, such as process management, adaptive transcoding, intelligent indexing, resource management, distribution, and scheduling for the entire system, so as to resolve various technological problems including the digital storage, coding management, retrieval query, material transcoding, and multi-channel distribution of the multimedia data and materials. In addition, it supports the multi-format resources distributed by all kinds of platforms, such as the Internet protocol televisions(IPTVs), mobile phones, and tablet personal computers (tablet PCs), thus providing the major guarantee to the e-learning of Shanghai citizens.

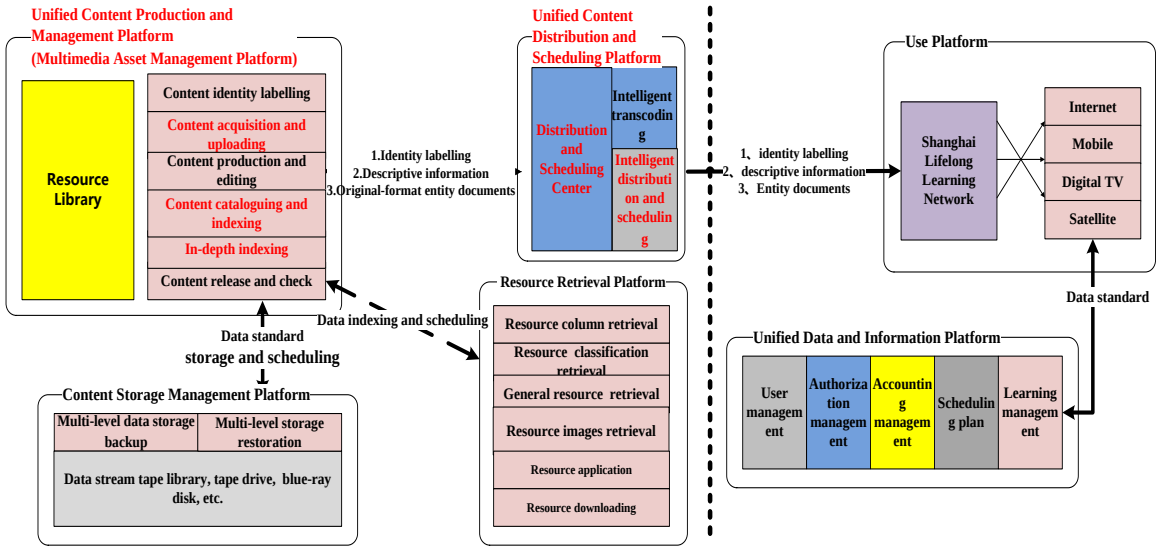

Figure4. Flow diagram of the system function

Function introduction

The multimedia asset management system is constructed by four platforms: (1) Unified content production and management platform (2) Unified content distribution and scheduling platform (3) Content storage management platform (4) Resource retrieval platform. Meanwhile, the platform of the system is composed of six sets of software for the achievement of specific functions.

The functional flow of multimedia asset management system is shown as Figure 4. Under the mutual effect of the four platforms, the management, transcoding, retrieval, distribution and scheduling, and storage of multimedia resources can be realized, to make the multimedia resources be applied to various receiving ends of different platforms flexibly, thus ensuring the study of the vast citizens.

(i) Function of unified content production and management platform

Multimedia asset management system could generate, and manage the unified content in the resource library, it can also provide digital learning resources with unified format for Shanghai Lifelong Learning Network. The function of unified content production and management platform specifically includes the content identity labelling, content acquisition and uploading, content production and editing, content cataloguing and indexing, in-depth indexing, and content release and check. This platform can support the generation of four formats of MPEG-2, WMV, H.264, FLV and MP4 [14]. Meanwhile, it establishes the in-depth video indexing and audio and video key frame indexing library with the strengthening of resource identity labelling function of the system.

Figure 5 shows the video adaptive transcoding process.

(ii) Function of unified content distribution and scheduling platform

The multimedia asset management system can conduct unified content distribution and scheduling for original-format entity documents with identity labelling and descriptive information in the content resource library of the production and management platform according to different tasks automatically. It then carries out the digitalized transcoding of resource content supporting multiple formats automatically, and transmits the correspondent resources to correspondent platforms for release, so as to complete the content distribution and scheduling of multimedia resource management system.

The above functions are realized through the unified content distribution and scheduling platform, which is composed of "intelligent transcoding software" and "intelligent distribution and scheduling software".

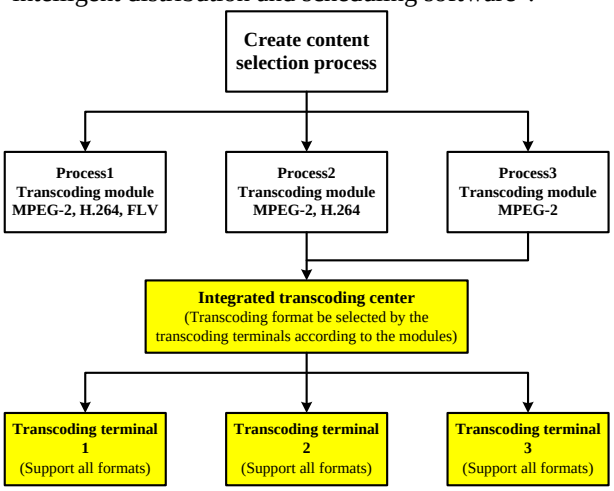

Figure5. Video adaptive transcoding process

Intelligent transcoding software is mainly for the purpose of realizing transcoding of multimedia asset management system, that is, to regulate the document in the content resource library and transcode the specified documents into assigned format in accordance with the system order.

Intelligent distribution and scheduling software could provide the automatic resource distribution function for the multimedia asset management system by matching the platform and correspondent resource format automatically in accordance with the users' choice, transmitting the relevant resource document to platforms, and generating the transmission log record. The process is shown in Figure 6.

(iii) Function of content storage management platform

The multimedia asset management system owns the function of multi-level data storage backup and multi-level storage restoration, and it supports various forms of backups in the data storage, such as data stream tape library, tape drive and blue-ray disk. In other words, when the educational resource content reaches the set capacity in the multimedia asset management system, it will be transferred to the tape library of the system automatically. Meanwhile, manual restoration and storage of the educational resource can be conducted in accordance with the users' needs.

(iv) Function of resource retrieval platform

Functions such as resource retrieval, application and downloading are available for Shanghai Lifelong Learning Network which can make learners not only conduct full-text search, but also execute advanced search based on images. Meanwhile, resources of the system can be released in accordance with different classifications such as call frequency, release time and theme service. This provides learners with modular resources present form, and makes learning platforms more instructive. The index process is shown in figure 7 [14].

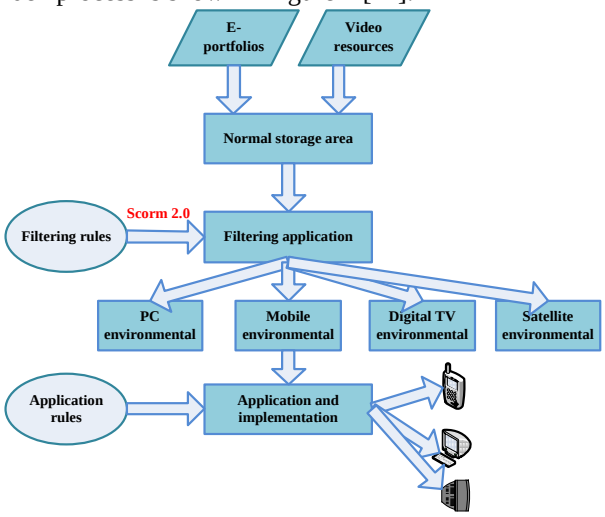

Figure6. The intelligent distribution and scheduling process

Affected by the three platforms of content production management, distribution and scheduling, and storage management jointly, the multimedia asset management system could renew the educational resource released by media asset centre timely, thus improving the interactive efficiency of users. In addition, the resource retrieval platform could allow users to browse and query all educational resource information in the database more conveniently. Moreover, subscription and unified downloading can be available for the required content. The manager could keep all order information of users in control and confirm the downloading permission of users to carry out unified downloading, so as to improve the work efficiency, promote management, and ensure the safety of educational resource.

System features

Based on the satisfaction of the essential requirements of the system, the multimedia asset management system which is applied in Shanghai Lifelong Learning Network gives full consideration to the availability, stability, reliability as well as the advancement, compatibility and expandability. Combining with the actual requirements of the content management, it aims to highly integrate with actual work and improve work efficiency. Therefore, the multimedia asset management system on the basis of the "multi-screen in one" back-end support technology owns the following features:

- Safe and reliable multimedia asset management system is with great operation reliability, which not only owns the error detection and correction capability but also has complete emergency plans with safe and convenient operation. Meanwhile, independent backup system could also prevent it from being influenced by the failure of the main system. In the operation process of the system, there are strict monitoring and management means for

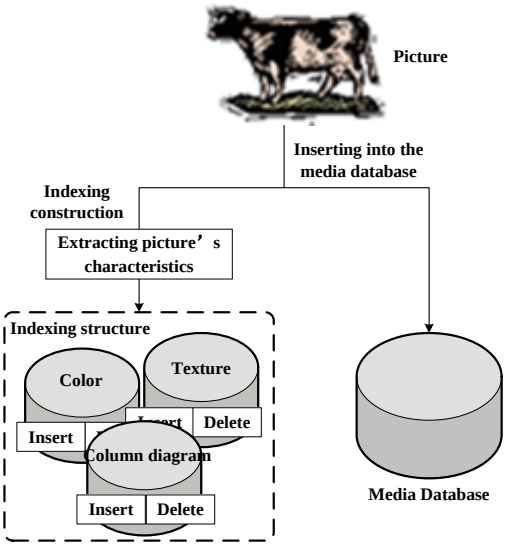

Figure7. The index process

various key factors. High safe and reliable guarantee the call, distribution and storage of learning resources.

- The processing of each link of the efficient multimedia asset management system is convenient and fast, which can conduct high-speed handling for tasks such as storage, call, transcoding, downloading and transfer of video resources. So it is with the characteristic of high efficiency.
- Open interface and technology is adopted for the open multimedia asset management system, thus allowing it to exchange data with other application systems conveniently with the advantage of openness. It makes learners access learning resources anytime and anywhere possible.
- Expanded multimedia asset management system could add the cataloguing sites conveniently for expansion of the storage capacity. So it is with the advantage of satisfactory expansibility. The storage capacity of Shanghai Lifelong Learning Network is with geometrical growth rate owing to satisfactory expansibility.
- Based on the ability to detect and correct errors with safe reliability, the maintainable and manageable multimedia asset management system could conduct detection and record for the entire network and facility operation through the unified network monitoring centre, so that the system can be maintained and managed well. It can also reduce the maintenance cost of Shanghai Lifelong Learning Network.
- Leading intelligent technology is adopted for network automatic multimedia asset management system in aspects such as cataloguing, database management and retrieval technology, which fully reflects the intelligentization and automatization of management, data processing and transcoding, retrieval and sharing, and data scheduling.

5.3 Personalized video resource recommendation system

System introduction

Personalized video resource recommendation system[15] is based on the collaborative filtering algorithm[16]. Learners can position the video resource accurately in the learning process after obtaining the unified identity authentication on the basis of the learning portfolio, so as to realize the multi-screen continuous study. According to the evaluation on resources by users as well as the relevant information among resources, the interest model of users can be constructed. Additionally, specific to the personalization requirements of learners, the complicated resources can be filtered according to the users' interest model and the video resources that might interest the users can be recommended, so as to support the personalized learning and achieve the intelligent video recommendation process. In a word, the personalized video resource recommendation system is a concrete realization of "multi-screen in one" front-end key technology for U-learning, and its application by Shanghai Lifelong Learning Network has provided great convenience to the query and browse of courses for users.

Function introduction

(i) Data support module

Data support module refers to an information database including four data tables, namely, user information table, learning behaviour data table, material information table and resource evaluation data table.

- User information table: The personal information of users including the basic information in registration and other relevant information obtained through Web data mining such as interest, habit and resource preference is stored in this table.

Learning behaviour data table: It is to preserve the learning behaviour record of learners in the study process. By tracing and recording the behaviour data of the learners, the system could analyse and extract those better reflect the resource preference of learners (such as the downloading, reading, collecting and recommendation of resources) and record them to the data table.

- Material information table: It preserves various learning resource information such as courseware, cases, tests, news and literatures.
- Material evaluation data table: It preserves the evaluation information of learning resources by learners.

(ii) Recommendation engine module of combinational algorithm [18]

This engine is the core module of the recommendation system [19] as well as the main centre for realizing personalized recommendation of learning resources. By retrieving the database, this module forms the evaluation matrix of users and resources. Then, forming the recommendation list in accordance with collaborative filtering algorithm [20,21].

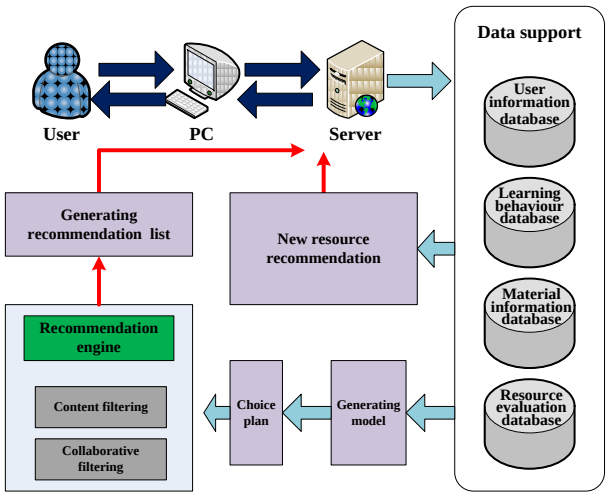

Figure8. Solutions for the personalized video resource recommendation system

Its algorithm process can be summarized into the following few steps:

Step1: retrieve the database and form the evaluation matrix of users and resources;

Step2: calculate and define the data sparsity;

Step3: According to the sparsity degree, the method can be selected to correct the collaborative filtering algorithm. Here we set a threshold value "Th-value" as the critical value to select the evaluation prediction or content filtering. When Sparsity ＜Th-value, it is considered that the system is in the state of "cold boot" or "pre-cold boot". At this time, the content filtering shall be selected as the correction for collaborative filtering algorithm. When Sparsity ＞Th-value, the evaluation prediction algorithm shall be adopted for correction;

Step4: form the adjacent users and generate the recommendation courses finally, so as to form the recommendation list in accordance with TOP-K.

According to the users' learning records, Shanghai Lifelong Learning Network can achieve relevant curriculum recommendation and improve the learning efficiency, and enhance capacity utilization and access of database resources.

(iii) New resource recommendation module

This module's main function is to analyse the interest, hobby and major (profession) categories of each learners, and recommend the latest resources in the relevant fields for them, so as to improve the click rate of the latest resources. The recommendation engine module of combinational algorithm is to retrieve and recommend existing resources. However, if a newly added resource hasn't been accessed or evaluated by learners, it will always be in the waiting line for visit and it will never get the chance to be recommended by this system. By adding such module, the cold boot problem in collaborative filtering can be conquered to certain degrees, so as to improve the click rate of learning resources that have been newly added to the library. In Shanghai Lifelong Learning Network, the effective visit mechanism of the new courses is available.

Figure 9 shows the key steps based on collaborative filtering algorithm in Shanghai Lifelong Learning Network.

Through the resource evaluation by adjacent users, this calculation process of recommendation aims to predict the evaluation on learning resources by targeted users: The evaluation of user i on program s is obtained by other users' evaluation on s (users in the adjacent user collection x). After predicting the evaluation of user i on the resource collection s, the top several resources with the biggest value shall be recommended to the user i.

Application case

The application of personalized video resource recommendation system in Shanghai Lifelong Learning Network with considerable success. Figure 9 shows the check of the intelligent recommendation system. Taking it as an example, a use has just finished the course of fund transaction, the right side of the window will show up the recommended courses for relevant study, work and interest.

As the user has just finished the course of "Fund Transaction" which belongs to the economics, we recommend the user another two economic courses of "Credit Risk Analysis Method" and "Political Economics" successfully on the right side of the window according to the study direction of the user.

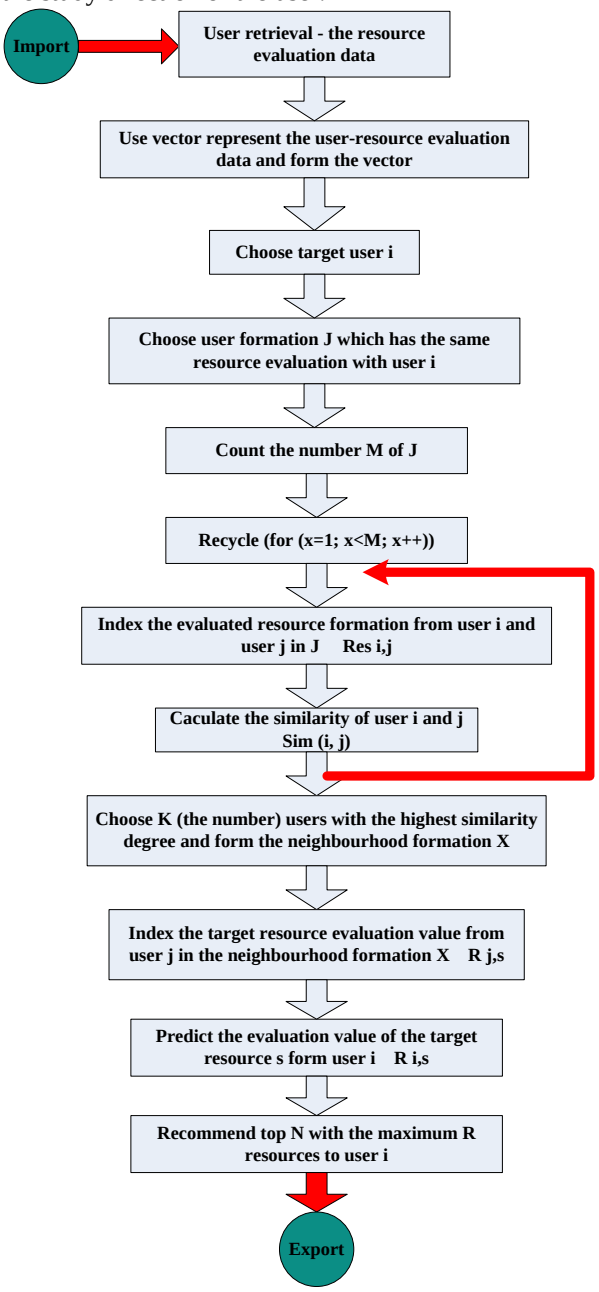

Figure9. Flow diagram of collaborative filtering algorithm realization for personalized course recommendation

Figure9. Check of the intelligent recommendation system

In addition, as the job orientation of the registered user is engineer, we recommend the "Engineering Mathematical Method" and "Design Algorithm Introduction" to him or her for further study.
According to the interest direction of science and technology, management and life that the user stored in the database, we recommend the user with "Science and Culture (2)", "All Answers for Life 49" and "Promoting Strategies" successfully. Therefore, it can be seen that this personalize course recommendation system could excavate and satisfy the demands of users well.

Additionally, we can also recommend high-quality courses with high evaluation by similar users on the basis of the collaborative filtering algorithm [22] in Shanghai Lifelong Learning Network. For example, as figure 10 shows, when a course of 'Nutrition and Diet Therapy for the Elderly" is clicked by a user, the most similar users with that user can be found out through collaborative filtering algorithm based on the user information table and learning behaviour table stored in the database, and then the course with best evaluation by those similar users will be recommended to that user by showing up on the right side of the window.

By searching with the algorithm, courses such as "Food Therapy and Health Care for Four Seasons (Spring)", "Source of Life 14", and "Pathetic Poet Begging for Food" are recommend to the user. Through the recommendation list, we can see that the theme of all courses is about health care, which owns satisfactory consistency. Besides, it verifies that good recommendation effect can be achieved by the personalized course recommendation system based on collaborative filtering algorithm.

5.4 The application of "multi-screen in one" system-Shanghai Lifelong Learning Network

Shanghai Lifelong Learning Network is a typical learning platform of U-learning on the basis of "multi-screen in one" system of education video. Since the official opening up of the Shanghai Lifelong Education Network on the 14th of April, 2009, the number of hits to the website within the first two weeks has reached 136000 and the free online registration has reached 132113. In addition, there are 1412 number of online courseware which last a total of 3300 hours. The establishment of Shanghai Lifelong Learning Network which is based on the "multi-screen in one" technology satisfies the needs of continuous learning and seamless joint learning environment. In U-learning environment, not only the continuous learning, but also the learning support service is necessary.

The same video resource can be transferred to various formats for terminal play such as WMV, MPEG-2, H.264 and MP4. The released courseware resource totals 5646.8 hours, among which, 12 categories have been formed by Shanghai educational resource library which owns more than 4000 episodes. In the application process

Figure10. Course recommendation of "Nutrition and Diet Therapy for the Elderly"

of Shanghai Lifelong Learning Network based on the support of multimedia asset management system, internet-based online study, digital TV-based VOD study and phone-based study mode have been realized, which provides more convenient learning environment for Shanghai citizens and allows them to conduct lifelong learning at any time in any place to the maximum degree.

The personalized video resource recommendation system, which is based on the key technology of "multi-screen in one" front-end support, provides a personalized learning support service for learners. It is more convenient for users to check the courses, which saves a lot of browsing and course finding time to a large degree and allows more users to be involved in the Lifelong Learning Network. In the operation of its resource alliance platform, over 80% of the trainees believe the course content on Lifelong Learning Network is abundant and approximately 90% of users speak highly of it and consider conducting lifelong study on it. The resource alliance platform of Shanghai Lifelong Learning Network has accumulated more than 8000 video courses, and its click rate has been increased by 12.4% on year-on-year basis ever since the application of personalized video resource recommendation system.

6. Conclusion

In the U-learning environment, learning equipment changes frequently with learners moving everywhere, so we need to find a solution for supporting the continuous learning effectively. Learners' tasks may be suspended at anytime and anywhere, and then can be continued at any time in another place with another equipment in this environment. So that learners cannot notice the noticeable differences despite changes of place, learning equipment and learning environment. The "multi-screen in one" system design of education video for U-learning proposed by this paper has filled up the lack of research in this aspect of the education field. It is based on "multi-screen in one" key technology and personalized video resource recommendation system. The actual application of it on Shanghai Lifelong Learning Network has presented the applicability and distinct advantages of "multi-screen in one" technology for U-learning. The multimedia asset management system could be in line with higher requirements such as video resource storage, transmission and retrieval in U-learning environment, which allows learners to obtain the video resources compatible with the network and facilities automatically while visiting the correspondent network. As for personalized video resource recommendation system, it could provide learning resources to users specifically along with better support for their personalized study. Therefore, these systems are with great user experience and convenience, which could carry out intelligent and efficient management on multimedia resources effectively. Meanwhile, they are in consistent with the development direction of personalized learning and U-learning, which helps users to get rid of the restriction from study terminals and realize the continuous lifelong learning.

In a word, oriented U-learning "multi-screen in one" technology of education video proposed in the paper has made up for the research vacancy in the education field. The research of the "multi-screen in one technology" not only realizes the share of the contents, but also achieves the seamless switching in the same learning resource on multi screens. Learners can access the needed learning resources using different devices at any time and place so as to ensure the continuation of the learning process. We should make great efforts continuously to promote the wide application and implementation of the "multi-screen in one" technology in this field.

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