Research and Design of Online Training Platform based on Spring Cloud Distributed System Structure and Computer Big Data

Xu Sun, Haonan Chen*, Qiaoyun Wang and Xu Liu

School of Economics and Trade, Jilin Engineering Normal University, Changchun 130052, China

*Corresponding author: lxy19720527@jlenu.edu.cn

Abstract. The thesis combines the national policy on the targeted poverty alleviation system and follows the adaptive efficiency principle of rural development, and designs a system that promotes the coordinated operation of government mechanisms and market economic mechanisms in the form of a new type of professional farmer training. The system combines and analyses the characteristics and needs of new-type professional farmer trainee skills training, and establishes a new-type professional farmer training platform and operating mechanism through information technology. The paper designs a new online training platform for professional farmers based on the spring cloud distributed system structure, which provides convenience for new professional farmers to participate in education and training.

1. Introduction

The report of the 19th National Congress of the Communist Party of China clearly pointed out that targeted poverty alleviation should be carried out nationwide, and the relationship between targeted poverty alleviation and new-type vocational farmer training should be coordinated and handled. With the development of information technology, the construction of agricultural modernization also has new connotations, among which the methods and methods of information technology should be adopted in the training of farmers accordingly [1]. Since the beginning of the 21st century, there have been some explorations in farmer training informatization, but compared with other industries, the overall level is lagging behind, and the use of modern information in the farmer training system needs to be further developed and improved. How to establish a farmer training information platform has always been one of the topics of studying the development of agricultural modernization. Computer technicians and educators have also been exploring the use of existing network technology to build a farmer training information platform suitable for national conditions.

2. The overall design of the information management system for the new-type professional farmer cultivation project

2.1. The way to achieve the goal of the training information platform

With the help of modern methods, to make training information reach the farmers who need it unimpededly, it is necessary to integrate existing agricultural information resources, establish an
information sharing mechanism, reduce farmers' choices, identify information links, shorten information transmission time, and expand information dissemination. At the specific design level, the platform can use agricultural information network and telecommunications network (Nonxenon) as a remote communication and feedback platform, and use computer and network technology to establish .NET-based XML Web Services, all-round and three-dimensional farmer training information platform. From a professional point of view, it is to integrate resources and build a platform for public agricultural databases, websites, and management systems with uniform standards and strong practicability [2]. At the technical level, the platform plays the role of information collection, sorting, analysis, release, feedback, and independent online learning in farmer training, so as to realize dynamic management of farmer training.

2.2. Framework design of information management system

The new-type professional farmer cultivation project management system studied in this paper adopts the B/S model and uses Java and JavaScript to code. In the research and development process, the technical structure used by the system is mainly the SSH structure, and the mode is MVC, as shown in Figure 1.

![Figure 1. The technical framework of the new-type professional farmer cultivation project management system.](image)

It can be found from Figure 1 that above the presentation layer is the application service, and the downward one is the session layer. Therefore, the bridge role played by the presentation layer is very obvious. Since the core position of the system is the business logic layer, it lies between the data access and presentation layers to better connect the entire system. The main function of the data persistence
layer is to connect and convert data [3]. Generally, it uses JDBC to complete data research and development. In the design process, the SSH structure cannot only make the original design modular, but also make the entire system more flexible.

2.3. Back-end functions of the training information platform
The "Farmer Training Information Platform" has multiple functions such as online learning, testing, questionnaire surveys, learning exchanges, learning feedback, resource inquiry, training management, etc. The special platform must have dynamic functions for general users (such as college student village officials, agricultural science and technology) create a small website by itself and upload it to provide an interface to facilitate uploading of functional modules [4]. The users of the system are composed of four users: trainee farmers, teachers, administrators and operators. After the user’s employment number or special number and personal password enter the system, it will prompt whether the user is a student, teacher, administrator, or operator. The farmer training information platform can be divided into the following basic modules in terms of function (see Figure 2).

![Figure 2. The basic structure of the training information platform.](image)

2.3.1. Data service. The modelling of the agricultural environment requires a large amount of meteorological data. In order to reduce the development difficulty of the business layer, database interface services, data management services, and import and export data services are provided in the basic framework layer [5]. The database interface service is designed for the low version of MySQL and MySQL databases. The data management service supports data in text format, and has low requirements on the system layer, which can meet the requirements of low-performance hardware equipment in rural areas.

2.3.2. Model control service. Crop growth model services, livestock growth model services, water, fertilizer, and drug model services use agricultural mathematical models, and dynamic models reflect changes in the entire agricultural environment. Using object-oriented technology, C++, etc. are
implemented as base classes, and business layer components can be modified or replaced. The information feedback service provides a strong training effect evaluation, and adopts the operation and feedback information-oriented human-computer interaction process to collect, store, and replay, saving storage space.

2.3.3. Three-dimensional visualization service. The agricultural entity model data mostly comes from actual production (such as DEM data, remote sensing monitoring data, animal and plant entity models, etc.), and the format is not uniform. The loading model service integrates a variety of 3D model formats (max, 3ds, etc.) to export to dts format; Load texture service, load height map service, skeletal animation service, and particle effect service are implemented using OpenGL and DirectX technology, providing a three-dimensional visualization scene.

2.3.4. Interface service. The human-computer interaction process is mainly provided by interface services, such as graphical user interface (GUI) creation, layout services, button creation, deletion services, font replacement, colour services, etc. to create a friendly interactive interface and reduce the difficulty of secondary development.

2.4. Front-end function framework
We design the various modules of the website according to the characteristics of regional agriculture, design a website suitable for farmer training, and effectively realize the direct information exchange between experts and farmers, farmers and farmers. In the design of training content, it is closely integrated with agricultural modernization and the rural economic structure of the region, taking into account the needs of farmers and market needs to achieve diversified training, and strive to ensure that the training content is not divorced from farmers and reality [6]. At the same time, with the help of the system, problems encountered in the process of agricultural production and marketing can be solved in a timely manner, and farmers’ enthusiasm for training and awareness of voluntary participation in training can be improved. The front-end framework of the website is shown in Figure 3.

![Figure 3. The front-end framework of the website.](image-url)
Agricultural information is mainly used to publish agricultural policies, agricultural news, website information and other related information, and recommend popular and latest information for users.

Courseware resources, e-books, and video resources mainly provide users with various forms of training content, and are divided into categories and sub-categories according to planting and breeding content for easy query and learning [7]. Among them, the courseware part also provides the function of collecting the content that users are interested in on the browsing page. The system can also recommend related content on-site and off-site resources based on the user’s browsing history. Off-site recommendations include different forms such as web pages, courseware, documents, and information. Users can choose the content they need to continue browsing and learning. This is also the characteristic function of this training system for intelligent search and recommendation learning based on a certain algorithm.

Experts Online mainly provides a place for users and experts to communicate. Users ask questions about agricultural policies, technology and other related issues. Experts can reply online to promote communication between learners and experts.

The agricultural forum is mainly used for discussion and exchange of information, agricultural technology, market and other content of the website, and provides most of the functions of the commonly used forums to enhance the user's stickiness.

The Agricultural Encyclopedia is mainly the explanation and introduction of some terms such as animals and plants, pharmaceuticals, diseases, etc., and provides a variety of query methods. The download centre provides users with downloading services of courseware, e-books, and videos, which is convenient for users to view and learn locally.

3. Recommendation algorithm for farmer training courses

3.1. Learning participation and interaction

The concept of participation has already had a lot of results in the research of traditional classroom teaching. Early studies defined learning participation as the behavioural performance of learning participation that students pay attention to and complete certain learning tasks. Afterwards, scholars continued to put forward new content and new definitions for the concept of learning participation. The current concept of learning participation adds learners’ emotional content to the original concept. It not only refers to students completing learning tasks, but also learning the positive cognition, behaviour, emotion and other performances in the process. In order to describe the learner’s recognition of the course more reasonably, based on the definition of learning participation, this paper proposes the concept of Interaction I, which refers to the average number of times a learner interacts with the course per unit time for a certain course of study. The quantitative formula is:

\[
I = \frac{\sum_{i=1}^{n} Q_{i} \times \frac{1}{R_{c}}}{T}
\]

(1)

Where: \(Q \) stands for the number of interactions, which refers to the total number of actions taken by learners such as taking notes, questions and answers, comments, homework, watching videos, etc. in a course; \(R_{c} \) stands for completion rate, which means someone’s progress in learning this course. That is, the ratio of the number of completed courses to the total number of courses; \(T \) represents the duration of the course; \(n \) is the number of learner samples.

3.2. Mahout recommendation algorithm

When making personalized recommendations, consider each user’s preferences as a vector. These user preferences are regarded as points in an n-dimensional space, each dimension represents an item, and the user’s preference value for the item is the value in this vector, the item that the user does not express preference is mapped to the 0 value in the dimensional vector. Since users usually only express their preferences for a small number of items, the values in the user vector are mostly zero, which is a
coefficient matrix. Multiply the co-occurrence matrix $M$ and the user vector $U$ to obtain the recommendation result $R$ as shown in the following formula:

$$
\begin{bmatrix}
  m_{11} & m_{12} & \cdots & m_{1n} \\
  m_{21} & m_{22} & \cdots & m_{2n} \\
  \vdots & \vdots & \ddots & \vdots \\
  m_{n1} & m_{n2} & \cdots & m_{nn}
\end{bmatrix}
\begin{bmatrix}
  u_{1i} \\
  u_{2i} \\
  \vdots \\
  u_{ni}
\end{bmatrix}
= 
\begin{bmatrix}
  R_{1i} \\
  R_{2i} \\
  \vdots \\
  R_{ni}
\end{bmatrix}
$$

(2)

Where: For course $x$, $u_{xi}$ represents the preference value corresponding to user $i$, and $R_{xi}$ is the recommended value. In the recommended value matrix $R$ obtained, the corresponding value of matrix $R$ is the recommended value of the corresponding course, and these values are selected from large to small the ranking is the recommended result. Based on the original Mahout Recommendation method, the IRS index evaluation is introduced, and the learner's scores of the courses that have been learned are used as the vector of user preference values, and the improved recommendation method is obtained. As shown in the following formula:

$$
\begin{bmatrix}
  m_{11} & m_{12} & \cdots & m_{1n} \\
  m_{21} & m_{22} & \cdots & m_{2n} \\
  \vdots & \vdots & \ddots & \vdots \\
  m_{n1} & m_{n2} & \cdots & m_{nn}
\end{bmatrix}
\begin{bmatrix}
  pre_{1i} \times k_{1} \\
  pre_{2i} \times k_{2} \\
  \vdots \\
  pre_{ni} \times k_{n}
\end{bmatrix}
= 
\begin{bmatrix}
  R_{1i} \\
  R_{2i} \\
  \vdots \\
  R_{ni}
\end{bmatrix}
$$

(3)

Where: $k_{x}$ is the ratio of $IRS_{x}$ (the IRS value of course $x$) to $\overline{IRS_{x}}$ (the average IRS value of all courses), namely $k_{x} = \frac{IRS_{x}}{\overline{IRS_{x}}}$; $pre_{xi}$ is the subjective score of learner $i$ on the corresponding course $x$, and $R_{xi}$ is learner $i$ Recommended results.

4. System Test

4.1. Connection speed test

The user's requirements for the response time of the Web page are generally harsh. If the response time of the Web system is too long (for example, more than 5s), the user will leave because of impatient waiting. In addition, an operation timeout error may occur due to the long response time. In this test, the main page of the system and the new user operation page were tested on the four networks of China Mobile, China Unicom, Telecom, and Intranet respectively, and the connection time of the two pages was recorded.

4.2. Stability test

Stability testing refers to testing the stability of the system when entering batch data at one time to ensure that the Web system can work normally within the scope of requirements. The stability level includes the number of users accessing the Web system at the same time and the number of concurrent online data processing, for example: How many users can the Web application system allow to be online at the same time, if the abnormal state of the system exceeds this number; the Web application system can Whether to process a large number of users' requests for the same operation. The stability test of the research adopts an automated test method. For different accounts, QTP software is used to record and write scripts, and 50 pieces of data are prepared respectively, and then the QTP scripts are run at different time periods to automatically enter data into the system and test the system the stability.
5. Conclusion
With the continuous popularization and application of computer and Internet technologies, it has become possible to make full use of modern distance education methods in rural areas to make them play an increasingly important role. The system just utilizes a large number of learning materials and information existing on the Internet, provides targeted information integration and learning content extraction according to the needs of users, and provides a platform for learning and resource recommendation anytime, anywhere, so as to establish farmer training Evaluation feedback and intercommunication mechanism. This not only provides farmers with learning content, but also accepts farmers’ online questions, feedback, evaluations, etc., and realizes the establishment of a feedback mechanism for training effects. Through the feedback mechanism, the site managers and the first-level government can promptly supplement the training content in the site, and provide targeted information services so that the training of farmers can achieve practical results.

Acknowledgments
This work was financially supported by Research on Teaching Reform of Vocational Education and Adult Education in Jilin Province, Project Name: Practical Research on the Training of New Professional Farmers, Project Leader: Sun Xu, Project Number:2018ZCY238.

References
[1] Mahmut, Ö. Z. E. R. The contribution of the strengthened capacity of vocational education and training system in Turkey to the fight against Covid-19. Yükseköğretim Dergisi, 10(2) (2020) 134-140.
[2] Ayub, H. Parental influence and attitude of students towards technical education and vocational training. International Journal of Information and Education Technology, 7(7) (2017) 534-538.
[3] Li, J., Wiemann, K., Shi, W., Wang, Y., & Pilz, M. Vocational education and training in Chinese and German companies in China: a ‘home international’comparison. International Journal of Training and Development, 23(2) (2019) 153-168.
[4] Gekara, V., & Snell, D. Designing and delivering skills transferability and employment mobility: the challenges of a market-driven vocational education and training system. Journal of Vocational Education & Training, 70(1) (2018) 107-129.
[5] Kleinert, C., Vosseler, A., & Blien, U. Classifying vocational training markets. The Annals of Regional Science, 61(1) (2018) 31-48.
[6] Hillmert, S., Hartung, A., & Weßling, K. A decomposition of local labour-market conditions and their relevance for inequalities in transitions to vocational training. European Sociological Review, 33(4) (2017) 534-550.
[7] Berchev, d. training of ncos from the bulgarian army as a part of the national system for vocational education and training. knowledge international journal, 22(4) (2018) 1075-1080.