Smart Campus Construction in the Big Data Era

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Abstract. With the rapid development of information technology, the information construction in colleges and universities has developed from the digital to the smart campus stage, and the big data era has arrived at colleges and universities. How to apply the big data technology to build a smart campus service platform is a subject to be faced by colleges and universities. In this paper, smart campus-related concepts are introduced. The overall design and implementation of smart campuses in colleges and universities currently are expounded and the problems in the construction are reflected.

Keywords: Colleges and Universities, Smart Campus, Data Integration, Cloud Service

1. Introduction
Increasing attention has been paid to the construction of educational informatization [1-2]. The 13th Five-Year Plan for educational informatization issued by the Ministry of education clearly states that “actively use new technologies such as cloud computing and big data to innovate the construction and application mode of resource platform and management platform” [3-4]. Colleges and universities respond positively, using cloud computing, Internet of things, big data and other technologies to integrate, analyze and share all kinds of school data [5-6]. In this paper, the “4-in-1” smart campus construction mode is proposed by using big data technology and integrating management platform, resource platform, data platform and mobile platform.

2. Connotation of Smart Campus
Smart campus comprehensively uses big data, mobile Internet, cloud computing, virtualization and other technologies to break the time and space constraints of traditional campus, integrate the independent and decentralized management information system and teaching resources in the campus into an organic whole with high perception capacity, coordination capacity and service capacity, and realize the overall perception of the environment, network interconnection and personalized service
for teachers and students, to regular operation, teaching management and public service of the school provide robust and intelligent support.

Smart campus has three core features: providing a platform for sensing environment and cloud services to offer personalized customized services for teachers, students and management departments, integrating the data of school management and student life in various fields through a unified interface for data processing, and converging in the cloud data sharing center to realize interconnection and cooperation, providing a platform for smart sensing environment and information services for schools and the outside world AC interfaces.

The construction objectives of smart campus include the following:

1. To establish a big data sharing and exchange platform. Based on the original campus construction, formulate unified standards, form an information standard system, integrate all kinds of management systems, build big data sharing and exchange platform, realize the synchronous exchange of data between business systems, and promote the sharing of campus information resources.

2. To ensure unified identity management and authentication. Simplify the process of users' access to the campus, unify users and access rights for centralized management, users can access all resources with rights only through one identity authentication, realize unified authentication of user identity and single sign-on, and improve the access experience of the smart campus.

3. To guarantee safety. The security design of smart campus refers to software and hardware operation environment, security system, planning, and management, including data security, network security, system security and other security system design.

3. Design of Smart Campus

Requires abandoning the current practice of digital campus business segmentation and relative closure, adopt an open, integrated and collaborative information architecture, implement the storage, offer personalized, on-demand, precision, and mobile services in smart campus, and create efficient and personalized campus information service platform, achieve the integration and optimization of all kinds of resources, to comprehensively management level, to play the overall effectiveness of smart campus.

The architecture of the smart campus is composed of the infrastructure layer, application support layer, data warehouse layer, platform integration layer, data standard and specification system and operation maintenance and security system. The system architecture of the software is shown in Figure 1 as follows.
Mobile software framework

**Interface layer**

**Logical business layer**

**Data layer**

**Physical link layer**

**Smart campus network**

**Server database**

**Figure 1.** System architecture of the software

Among them, the realization of large-scale application system virtualization management, the development of university data warehouse, covering the school, the construction of teachers and students through the integration of structured data, to provide services for the management platform and support for decision-making data platform, through the integration of unstructured data, the establishment of a resource sharing platform. Finally, the mobile platform is completed to implement the smart campus with full coverage at both the PC and the mobile terminals.

**4. The Implementation of Smart Campus**

For the smart campus in the big data context described in this paper, a college is taken as an example to describe the specific implementation as follows:

The school now has more than 70 application systems covering teaching, management, service and resource. However, due to the inconsistent system architecture and data standards, it has formed a “Information island”. A unified and standardized database is formed, and 20 common business systems are integrated. The unified authentication, data and portal are completed, and the one-stop service of the management platform is realized first. The management platform realizes system single sign-on, information push on-demand and personal information portal. From the personal level, teachers and students can obtain personal information related to themselves, such as salary, grade, schedule, etc. from the management level, the Department can handle reminders of process nodes, such as official document circulation, reward and attendance assistance loan, etc. from the school level, leaders can directly query the comprehensive school affairs, such as new year, school leaving, etc.

The big data analysis algorithm is used to meet the training error requirements, such as the number of samples, average error and maximum error, combined with the simulated annealing algorithm, the fitness function is defined as follows
\[ f_i = c_1 \cdot \frac{n}{S} + c_2 \cdot \frac{1}{(1 + \max(E))} + c_3 \cdot \frac{1}{(1 + \text{avg}(E))} \]  

(1)

Where the coefficients \(c_1, c_2, c_3 \in (0,1)\), the sum of the three is \(1\), the error formula of neural network training samples is \(E_g = \exp(-g/C)\), \(G\) represents the current generation algebra, \(C\) represents the constant (its value is determined by the training accuracy), \(E\) represents the error between the individual and the sample.

There are two deficiencies in the operation of traditional cm: Firstly, it is easy for good individual offspring to flood the population prematurely in the early stage of operation. Secondly, it is easy for the network to stop changing due to the stable adaptation in the late stage of operation, which causes the stagnation of the evolution of the whole population, and the advantages of the offspring of excellent individuals in the network are no longer obvious. In this paper, when SA is used to optimize the compression matrix, its fitness function is stretched, i.e., equation (1) can be transformed into the following

\[
\frac{\exp \left( \left( c_1 \cdot \frac{n}{S} + c_2 \cdot \frac{1}{(1 + \max(E))} + c_3 \cdot \frac{1}{(1 + \text{avg}(E))} \right) \right)}{T} \]

\sum_{i=1}^{M} \exp \left( \left( c_1 \cdot \frac{n}{S} + c_2 \cdot \frac{1}{(1 + \max(E))} + c_3 \cdot \frac{1}{(1 + \text{avg}(E))} \right) \right) / T

(2)

\[ T = T_0 \cdot C^{e-1} \]  

(3)

Where \(f'_i\) represents the fitness of the changed function, \(M\) represents population size, \(g\) represents the current generation, \(T_0\) and \(C\) represent constants.

In the teaching at colleges and universities, multimedia teaching resources and teaching methods have become indispensable means. The school's unstructured data (video, audio, image and document data) has shown a rapid growth trend. A large number of resources are stored in various departments or independent application systems, forming a large number of “resource islands”. Teachers and students in any existing system can not achieve the centralized retrieval of unstructured data resources, fast access to valuable information. The resource platform is not only different from the traditional video on-demand system, but also different from the general cloud storage system. It is a resource platform in the sense of integration. All kinds of teaching systems in the school can call resources from the resource platform to realize one storage and multiple applications of resources. Meanwhile, the construction of the resource platform can implement and make every teacher and student not only users but also creators of resources through the construction of personal space and personal network
disk, which significantly enriches the campus multimedia resources. Through the development of a resource platform, the “unstructured data warehouse” at colleges and universities can be constructed. Data integration extends from structured data to unstructured data, marking the comprehensive integration of different types of data. So far, the school constitute the unified data warehouse of the smart campus.

The school has built more than 70 kinds of business systems but also produced and accumulated a large number of data. However, these data are stored in their respective databases and are not fully leveraged. School managers hope to be able to survey the statistical data of the whole school, transfer the data from the bottom of each system to their desktop, and achieve accurate university management. The construction of a data platform is to implement data mining and analysis across departments and systems. Through the integration of personnel system, learning and engineering system, dormitory system, welcome system, school leaving system, book system, financial data, one card, etc., with different theme models and data dimensions, panoramic display of school situation analysis, induction of teaching activities and management rules, thus providing accurate data services for modern university governance. Figure 2 shows the login interface of the smart campus cloud resource utilization App based on big data.

![Figure 2. System login interface of Smart Campus App](image)

5. Conclusions
To construct the smart campus in the current context of big data and realize the transformation from digital to smart campus, we need to build structured and unstructured data warehouses based on the two major types of data. In this way, each business system accesses the corresponding database
appropriately. In addition, the data warehouse shall provide data support for management, resource, data, and mobile platforms to implement mutual authentication data sharing. As the four pillars of smart campus, these four platforms form the architectures, which is also in line with the “three connections and two platforms” put forward by the Ministry of Education. During information construction, colleges and universities should make their exploration in practice, without “Comparing unrealistically” or pursuing the “Best” blindly. Instead, they should take the reality of school information construction into full consideration, follow the data integration pattern, and customize a smart campus that is the best fit for their conditions.

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