Research Article

Open Sharing Management of Artificial Intelligence Laboratory Based on Deep Fusion of Big Data

Caizhi Liang

Academic Affairs Department, Guangdong Industry Polytechnic, Guangzhou, Guangdong 510000, China

Correspondence should be addressed to Caizhi Liang; 3100501058@ca.edu.cn

Received 26 July 2022; Revised 20 August 2022; Accepted 30 August 2022; Published 14 September 2022

Academic Editor: Balakrishnan Nagaraj

Copyright © 2022 Caizhi Liang. This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

In order to improve the efficiency of information management of open laboratories in colleges and universities and reduce the cost of information management of open laboratories in colleges and universities, this paper proposes the open sharing management of artificial intelligence laboratories based on the deep integration of big data. The infrastructure layer of the system transmits the information management data of the university open laboratory to the cloud platform layer. The cloud platform layer completes the data management, cloud computing, and access control and transmits the processed data to the application layer. The application layer realizes the information management of the university open laboratory according to the data fed back by the cloud platform layer. Among them, in the process of data transfer in open laboratories of colleges and universities, pyramid technology is used to realize data transfer, and the optimization calculation of particle swarm optimization algorithm is used to complete the transfer of multidimensional and complex data transmission information, so as to improve the efficiency of data transfer. The experimental results show that the system has high accuracy in transferring multidimensional and complex data in university open laboratories, the average resource utilization rate of the system is as high as 92%, the average response of the system is as fast as 8.5 ms, and the management cost is effectively reduced. Conclusion. The system designed in this paper can reduce the information management cost of open laboratories in colleges and universities.

1. Introduction

The Internet has developed rapidly in recent decades, and it has been applied in all walks of life. More and more enterprises, schools, and families cannot live without the use of the Internet [1]. In order to meet the growing market demand and continuously conform to the process of social development, the intelligent and convenient Internet of things came into being on the basis of the Internet. The Internet of things technology is a combination of Internet technology, telecommunications technology, and IT technology [2, 3]. As far as China is concerned, the Internet of things is defined as a network that connects any object we need to use with the Internet through RFID technology, infrared sensing, Bluetooth, and other information technology sensors according to the specified protocol and then carries out communication and data exchange to achieve intelligent identification, supervision, and management. In other words, through the induction system, we can perceive the physical objects, connect the induction system with the Internet, interact the sensed things with the Internet, realize the exchange of information, and realize the requirements of intellectualization [4].

In recent years, with the continuous deepening of higher education reform, especially driven by the construction of “teaching evaluation” and “quality engineering,” colleges and universities pay more attention to the cultivation of students’ practical ability and innovation ability [5]. The role of open laboratories in cultivating innovative and applied talents is increasingly prominent [6]. However, at the same time, university laboratories are facing the following two new situations: on the one hand, the state’s investment in higher education is increasing, and a large number of high-quality advanced instruments and equipment have entered the laboratory. The use of these public resources requires the opening of the laboratory to be more full and effective [7, 8]. On the other hand, the number of students in colleges and universities is growing, and some experimental teaching
resources are insufficient, which also requires the laboratory to be effectively and reasonably open, so as to maximize the use efficiency of instruments and equipment.

With the development of society and the continuous progress of computer level, Internet of things technology has entered our vision [9]. The Internet of things has gradually become an important part of the new generation of information technology, showing its powerful functions and playing an important role in promoting the development of the entire information industry [10]. The design of laboratory intelligent control system based on Internet of things should grasp the design principles, take teaching as the purpose, and improve the intelligent management level of the laboratory [11]. At the same time, the performance of the laboratory should be strictly monitored. The intelligent connection between devices plays an important role in the maintenance and repair of devices.

2. Literature Review

With the expansion of the scale of colleges and universities, the number and types of instruments and equipment owned by laboratories have increased, their value has increased, and their scientific and technological content and precision have improved, resulting in the overall level of experimental technicians not keeping up with the development of instrument hardware construction, which has seriously affected the full play of the advanced functions of instruments in teaching and scientific research [12]. The reform of experimental teaching system and open laboratories has also increased the workload of experimental technicians so that they do not have enough time to carefully maintain and maintain instruments and equipment, develop the functions of instruments and equipment, let alone scientific research and innovation [8, 13]. The instability and slow development of the experimental staff have seriously hindered teaching reform and scientific research innovation. The operation of open laboratories makes the teaching and scientific research activities of university laboratories more frequent, and the full-time laboratory personnel are obviously insufficient. It is common for temporary workers and students to be on duty in the laboratory, but the corresponding safety measures are often not implemented, leaving many potential safety hazards to the laboratory.

The open laboratory in colleges and universities is the core place of teaching resources in colleges and universities, which mainly provides students with academic exchanges, experimental courses, social skills training, graduation design, and other services [14]. College students can make full use of the open laboratory of colleges and universities to implement independent experiments to improve their practical ability, deeply understand the theoretical knowledge in the course in the process of experiments, and combine theory with practice. In order to improve the overall academic level of college students, major colleges and universities across the country attach great importance to open laboratories in colleges and universities and constantly update and improve the construction of open laboratories in colleges and universities and the development of information management systems [15]. Teachers of open laboratory management in colleges and universities can realize the management of online experimental courses and integrate laboratory teaching resources through the management system. However, at this stage, there are still some problems in the information management of open laboratories in colleges and universities, such as uneven laboratory dispersion, low information sharing, and high system maintenance cost.

The previously designed university open laboratory information management system has some defects. The laboratory management system based on Wi-Fi sniffer technology designed by Raj and others requires the deployment of multiple Wi-Fi sniffers in the process of university open laboratory information management, resulting in increased management costs [16]. The information management system of testing laboratory based on PyVISA designed by Li and others is difficult to effectively transmit information during the management process, which reduces the management efficiency [17]. Cloud desktop technology connects all applications through cloud platform, pushes the information data required by users according to the requirements of users, and realizes information sharing between cloud platform system and users [18]. Therefore, this paper designs an information management system of university open laboratory based on cloud desktop technology to realize the comprehensive and efficient management of university open laboratory information.

3. Method

3.1. University Open Laboratory Information Management System Based on Cloud Desktop Technology

3.1.1. Overall System Structure. In order to improve the efficiency of university open laboratory information management, a university open laboratory information management system based on cloud desktop technology is designed. The overall structure of the system is shown in Figure 1.

It can be seen from Figure 1 that the system is composed of infrastructure layer, cloud platform layer, and application layer. Among them, cloud desktop technology is the guarantee of system operation. The infrastructure layer is composed of hardware, network, and access control components. The infrastructure layer transmits the information management data of university open laboratories to the cloud platform layer, which is the core of the system, and completes data processing and computing in the cloud platform layer. In the data management module, pyramid technology is used to realize data transfer, and particle swarm optimization algorithm is used to optimize the data transfer process of university open laboratory. The processed data is transmitted to the application layer, which realizes the information management of university open laboratory according to the data feedback by the cloud platform layer [19].

3.1.2. System Hardware. The hardware of the system is composed of network switch, knife box, server, and client. The whole system uses three H3C UIS knife boxes, and the server
is configured with H3 blades with 256g and 20g integrated network cards. It is mainly responsible for providing infrastructure guarantee for the system software and improving the running speed of the software.

3.1.3. Optimization of Data Transmission Information Transfer Accuracy

(1) Definition of Data on Storage Primary Key. In the data management module, pyramid technology is used to implement the data transmission information transfer of open laboratories in colleges and universities. In order to obtain the pyramid number of the data transfer decision point, the data is abstracted into a group of binary key values, and the metadata transfer range is given. The amount of data stored in the primary key is to give priority to the data sub-stream with the best quality through the coordinates of the central point and the difference between the judgment points, sort according to the weight of the sub stream, and adjust all the relevant variables of the transferred data, so as to realize the real-time update of the size of the data transferred sub interval.

Suppose that the one-dimensional index of the b-dimensional vector of metadata refers to $b_v$ description, and the node is described by $N_{i}^j$. According to the logical function, it is divided into transfer node and storage node, which are described by $IN_{i}, SN_{i}$, respectively. The data is abstracted into a set of binary key values by using pyramid technology. The specific calculation process is described in

$$B(z, o) = \frac{N_{i} \otimes IN_{i}}{SN_{i}}. \quad (1)$$

Suppose the metadata is described by $v_{j}$, and the specific transfer process is described by

$$v_{(1)j} = \left(v_{j} - v_{j \ min}\right) \times B(z, o) \frac{v_{j \ max} - v_{j \ min}}{[0, 1]} \times \left[v_{j \ max} - v_{j \ min}\right]. \quad (2)$$

Among them, the normalized value is described by $v_{(1)j}$, and the value range of metadata is described by $v_{j \ max}$ and $v_{j \ min}$, respectively.

Set the data transfer judgment point to be described with $a$, the pyramid number of the data transfer judgment point to be described with $i$, and its calculation is described with

$$j_{\ max} = \left(\frac{j_{h_{b_{v}}}}{id_{v}}\right) v_{(1)j} \otimes \Phi. \quad (3)$$

Among them, the interval of one-dimensional index range is described by $\Phi$, and the coordinate difference of center point $p$ in the $i$-th dimension and the largest one-dimensional vector in data transfer decision point $A$ are described by $(j_{h_{b_{v}}})$.

Suppose that the data transfer request is described by $Q_{(P_{j})}$, the effective node of any data transfer in the database is described by label, and the probability that each transfer value has a common prefix with the binary number is described by $\delta(u)$. Define the amount of data storing the primary key by selecting the common prefix through formula (4), and its calculation is described by

$$P_0 \ min = \frac{Q_{(P_{j})} \times \text{label} \otimes \delta(u)}{SN_{i} \otimes q_{j \ min}} \otimes \text{available}. \quad (4)$$

Let any node in the data center be described by $N_{\ ini}$. When $B$ is submitted to any node in the data center, the dynamic adjustment of the size of the data transfer subinterval is implemented by

$$\text{INdex} = \frac{N_{\ ini} \otimes B}{M_{ij} \otimes IN_{i}^\star} \times \text{available} \times j_{\ max}. \quad (5)$$

Among them, the effective node with the largest number of transfers is described by $M_{ij}$.

Let the number of different substreams be described with $i'$, the mapping relationship between the data layer and the

![Figure 1: Overall structure of the system.](image)

Wireless Communications and Mobile Computing
Let the quality of each substream be described with \( QS_i \), and the calculation formula of \( F(X_i) \) is described by

\[
F(X_i) = \frac{P_{\text{best}} \otimes V^{k+1}_i}{S(X_i, P_{\text{best}})} \otimes S(X_i, P_{\text{best}}). 
\] (13)

Among them, the storage address before data transfer is described with \( S(X_i, P_{\text{best}}) \), and the number of data transfer node sets is described with \( S \).

The global optimal position is described by \( k_{\text{best}} \), and the formula for real-time adjustment of particle position is described by

\[
(k_{\text{best}}) = \frac{k_{\text{best}} \otimes F(X_i)}{M_n^p(X_i)} \otimes U_{ri} \times T_s. 
\] (14)

Among them, the interface grid data set is described by \( M_n^p(X_i) \).

3.2. Experimental Analysis. In order to verify the performance of the design management system, the simulation comparative verification experiment is carried out. The specific steps of the experiment are as follows.

Step 1. Select the experimental object, determine the size of the experimental data, and select the simulation tool used in the experiment.

Step 2. Determine the operating parameters of the system during the simulation experiment to ensure the reliability of the experimental results.

Step 3. Select the comparison system used in the experiment to highlight the performance of the designed system.

Step 4. Set the experimental indicators, including the time of system data transfer, root mean square error of data transfer, resource utilization, success rate of data transfer, response time, and management cost.

Step 5. Carry out the comparative experiment of different systems, get the experimental results, and analyze the experimental results.

The flowchart of experimental steps is shown in Figure 2.

The information management work of an open laboratory in a university is selected as the experimental object. The experimental data is the information management data of the open laboratory in a university. The total amount of data is 20 GB. The simulation tool used in the experiment is PlantSim.

The comparison systems used in the experiment are the laboratory management system based on Wi-Fi sniffing technology and the detection laboratory information management system based on PyVISA. The experimental indicators are the time of system data transfer, root mean square
error of data transfer, resource utilization, success rate of data transfer, response time, and management cost.

4. Results and Analysis

In order to test the performance of data transfer in this system, 1000 data were randomly selected in the experiment, and three systems were used to implement the transfer experiment of multidimensional complex data transmission information. The time of data transfer and the root mean square error of data transfer in the three systems were compared, and the results are described in Figures 3 and 4.

From the comparison results of the system data transfer time in Figure 3, it can be seen that under the condition of continuous increase in the amount of data, the data transfer time of the system in this paper is the lowest, and the average data transfer time is 39 ms, which is 17.3 ms and 10.5 ms faster than the other two comparison systems, respectively. Therefore, it shows that this system can efficiently realize the transfer and storage of laboratory data.

According to the comparison results of the root mean square error of data transfer shown in Figure 4, the root mean square error of the system in this paper is much lower than that of the other two comparison systems. The maximum root mean square error of the system in this paper is 0.04, while the maximum root mean square error of the laboratory management system based on Wi-Fi sniffing technology and the detection laboratory information management system based on PyVISA is 0.96 and 0.54, respectively.

The reason why this system has higher data transfer efficiency and lower root mean square error is that in the process of data transfer, pyramid technology and particle swarm optimization algorithm are combined to improve the efficiency and accuracy of data transfer.

In order to verify the overall superiority of the system in implementing data transfer, three systems are used to test the resource utilization rate and the success rate of data transfer after the implementation of multidimensional complex data transmission information transfer in university open laboratories.

In order to further verify the performance of the system, three system response time experiments are compared. The experimental results are described in Figure 5.

It can be seen from Figure 5 that the response time of the system in this paper is significantly higher than that of the other two comparison systems. The average response of the system in this paper is 8.5 ms, which is 12 ms and 9 ms faster than that of the other two comparison systems, respectively. It shows that the system response time is fast and the system performance is good. The reason is that this system
first designs a three-tier system architecture and designs an efficient and high memory server in the hardware part of the system, which reduces the response time of the system.

The experiment tests the information management cost of open laboratories in colleges and universities before and after the application of the three systems, and the results are described in Table 1.

According to the analysis of Table 1, compared with the other two systems, the cost of the university open laboratory information management system designed in this paper is lower. The management cost of this system is 1.17 million yuan, which is 640000 yuan and 1.11 million yuan less than the other two systems, respectively. It shows that in the process of realizing the information management of open laboratories in colleges and universities, this system can reduce the cost of laboratory information management.

5. Conclusion

This paper proposes the open sharing management of artificial intelligence laboratory based on the deep integration of big data. In order to improve the efficiency of information management of university open laboratory, an information management system of university open laboratory based on cloud desktop technology is designed. In the process of data transmission and information transfer, pyramid technology is used to transfer multidimensional data into one-dimensional index, and the data conversion quality is the best according to the weight of substreams. At the same time, particle swarm optimization is used to optimize the data transfer process of open laboratories in colleges and universities, so as to realize multidimensional complex data transmission and information transfer, optimize the accuracy of data transmission and information transfer, and ensure the high-quality operation of the management system. The experimental results show that in the process of realizing the information management of open laboratories in colleges and universities, this system can reduce the cost of information management of open laboratories in colleges and universities and improve the efficiency of information management of open laboratories in colleges and universities.

Data Availability

The data used to support the findings of this study are available from the corresponding author upon request.

Conflicts of Interest

The author declares that there are no conflicts of interest.
Acknowledgments

The study was supported by the research project on the sharing mechanism of experimental training resources of Guangdong Industry Polytechnic in 2018—construction of open sharing platform of Higher Vocational laboratory—taking Guangdong Industry Polytechnic as an example “(kjrr2018010).”

References

[1] W. Jin, Y. Liu, Y. Jin, M. Jia, and L. Xue, “The construction of builder safety supervision system based on cps,” Wireless Communications and Mobile Computing, vol. 2020, Article ID 8856831, 11 pages, 2020.

[2] M. Bartczak, “The implementation process of management by values as a response of companies to the growing requirements of the market,” Zeszyty Naukowe Wyższej Szkoły Humanitas Zarządzania, vol. 21, no. 1, pp. 77–89, 2020.

[3] S. Safdar, S. A. Khan, A. Shaukat, and U. Akram, “Genetic algorithm based automatic out-patient experience management system (gapem) using rids and sensors,” IEEE Access, vol. 9, pp. 8961–8976, 2020.

[4] J. Wang, “Massive information management system of digital library based on deep learning algorithm in the background of big data,” Behaviour and Information Technology, vol. 40, 2020.

[5] S. Zhang, C. Lu, S. Jiang, S. Lu, and N. N. Xiong, “An unmanned intelligent transportation scheduling system for open-pit mine vehicles based on 5g and big data,” IEEE Access, vol. 8, pp. 135524–135539, 2020.

[6] M. Yelvington, “Goniometry: a skills-focused approach to using a simulation laboratory,” Burns Open, vol. 5, no. 4, pp. 73–74, 2021.

[7] S. D. Pawar, S. S. Kode, S. S. Keng, D. S. Tare, and P. Abraham, “Steps, implementation and importance of quality management in diagnostic laboratories with special emphasis on coronavirus disease-2019,” Indian Journal of Medical Microbiology, vol. 38, no. 3–4, pp. 243–251, 2020.

[8] M. Zhang, “Suggestions on the reform of student centered experimental teaching,” International Journal of Social Science and Education Research, vol. 2, no. 11, pp. 120–122, 2020.

[9] L. Wu, J. Zhou, and Z. Li, “Applying of ga-bp neural network in the land ecological security evaluation,” IAENG International Journal of Computer Science, vol. 47, no. 1, pp. 11–18, 2020.

[10] J. Fei, Q. Yao, M. Chen, X. Wang, and J. Fan, “The abnormal detection for network traffic of power iot based on device portrait,” Scientific Programming, vol. 2020, Article ID 8872482, 9 pages, 2020.

[11] K. Sharma and B. K. Chaurasia, “Trust based location finding mechanism in VANET using DST,” in 2015 Fifth International Conference on Communication Systems and Network Technologies, pp. 763–766, Gwalior, India, 2015.

[12] D. A. López, M. J. Rojas, B. A. López, and O. Espinoza, “Quality assurance and the classification of universities: the case of Chile,” Quality Assurance in Education, vol. 28, no. 1, pp. 33–48, 2019.

[13] A. Saar, M. McLaughlin, R. Barlow, J. Goetz, S. A. Adediran, and A. Gupta, “Incorporating literature into an organic chemistry laboratory class: translating lab activities online and encouraging the development of writing and presentation skills,” Journal of Chemical Education, vol. 97, no. 9, pp. 3223–3229, 2020.

[14] K. Wu, X. Jin, and X. Wang, “Determining university students’ familiarity and understanding of laboratory safety knowledge—a case study,” Journal of Chemical Education, vol. 98, no. 2, pp. 434–438, 2021.

[15] Q. Tang, Y. Zhao, Y. Wei, and L. Jiang, “Research on the mental health of college students based on fuzzy clustering algorithm,” Security and Communication Networks, vol. 2021, Article ID 3960559, 8 pages, 2021.

[16] M. P. Raj, P. Manimegalai, P. Ajay, and J. Amose, “Lipid data acquisition for devices treatment of coronary diseases health stuff on the Internet of medical things,” Journal of Physics: Conference Series, vol. 1937, article 012038, 2021.

[17] L. Li, Y. Diao, and X. Liu, “Ce-Mn mixed oxides supported on glass-fiber for low-temperature selective catalytic reduction of NO with NH₃,” Journal of rare earths, vol. 32, no. 5, pp. 409–415, 2014.

[18] G. Veselov, A. Tselykh, A. Sharma, and R. Huang, “Applications of artificial intelligence in evolution of smart cities and societies,” Informatica (Slovenia), vol. 45, no. 5, p. 603, 2021.

[19] H. Xie, Y. Wang, Z. Gao, B. Gantia, and C. Truong, “Research on frequency parameter detection of frequency shifted track circuit based on nonlinear algorithm,” Nonlinear Engineering, vol. 10, no. 1, pp. 592–599, 2021.