

Research Article

Grid Information Integration Platform of Student Dormitory Based on Edge Computing

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In order to solve the problem that the average response time of the grid information integration platform in student dormitories is too long, a grid information integration platform for student dormitory based on edge computing is proposed. In terms of hardware, on the basis of clarifying the principle of edge computing, the overall framework of the platform is built based on the B/S structure. The central unit, power supply circuit, LCD display, signal processor, and power supply of voltage regulator in the framework are optimized. In terms of software, a three-level data integration model combined with a two-way mapping strategy is used to establish a grid warehouse in student dormitories. Based on the distributed link structure and the principle of management domain, the distributed data acquisition technology is designed to collect the grid information of students' dormitory in real time and store it in the warehouse. Using the IFB tree structure in the edge computing branch, the edge computing data query model is constructed. Finally, the grid information integration algorithm of student dormitory is designed to realize the grid information integration of student dormitory. The platform test results show that the average response time of the design platform is less than 2.426 s, which meets the timeliness requirements of data integration management.

1. Introduction

With the development of the big data era, many fields have begun to take the data analysis results as the basis for future development [1] and make decisions more in line with the development trend of the times based on historical data. For the grid information of student dormitories, due to its strong relevance, the regularity of grid information of student dormitories can be directly presented through data mining and integrated analysis [2, 3], and the key information contained in grid information of student dormitories can be extracted, so as to ensure the stability of university management and student behavior. Among them, information integration is one of the most basic links, and the existing integration platform is obviously difficult to play a better application effect.

Reference [4] puts forward the grid management mode of college students in the epidemic situation. In this study, it is pointed out that counselors play a positive role in improving students' ideological and political literacy, promoting the smooth operation of student management, and

maintaining campus security and stability. Under the epidemic situation, management needs to pay more attention to detail and reality. Grid management has the advantages of rapid response, cross sharing, and efficient linkage. Therefore, based on grid management, combined with the characteristics and opportunities of college counselors during the epidemic prevention and control period, this study will explore the optimization of student management methods. In order to better improve the efficiency of student management in colleges and universities, reference [5] puts forward a people-oriented management concept, that is, colleges and universities should clarify the management responsibilities of student management, increase the resource investment of student management, strengthen students' ideological and political education and guidance, ensure that students' reasonable needs are met, and improve students' comprehensive quality. Reference [6] dialectically analyzes the prominent problems of college student management in the big data environment and analyzes the fit of grid management mode to college student management. Finally, it summarizes the methods of constructing the grid

management mechanism of college students in the big data environment so as to provide theoretical reference for relevant research. Reference [7] points out that due to the deviation of the grid management concept of student crisis events in colleges and universities, the imperfect organization system, the aging and slow updating of management platform, the lack of crisis education for college students, and the development and implementation of grid management of student crisis events in colleges and universities are not optimistic. Colleges and universities should establish a scientific concept of crisis event management, improve the systematic crisis event management system, build an efficient crisis event management platform, and strengthen the necessary crisis event education and training so as to further improve the management mechanism of students' crisis event handling.

Although the above platform realizes integrated management, its data query response time is long. Therefore, this paper proposes to integrate edge computing technology into the construction of grid information integration platform in student dormitories. The hardware and software are optimized. By establishing the grid warehouse of the student dormitory and designing the distributed data acquisition technology, the grid information of the student dormitory is collected in real time and stored in the warehouse. The IFB tree structure in the edge computing branch is used to construct the edge computing data query model. The grid information integration algorithm of student dormitory is designed to shorten the response time of the platform and improve the efficiency of information integration.

2. Overall Architecture of Grid Information Integration Platform Based on Edge Computing

Referring to the concept and function of "grid" in computer science, in recent years, the concept of grid management has been widely used in urban and rural grass-roots governance and has become an important method of grass-roots social management [8, 9]. Specifically, it is to divide the people, things, and things carried in the physical space into unit grids according to certain standards; establish a dynamic and all-round management system for each grid area; realize the main functions of resource sharing, collaborative work, dynamic adjustment, and high expansion in the grid; and then implement more diversification and refinement, and personalized management and service to promote the grid management of college student dormitories is the need to improve the school's governance ability. College student dormitories have the characteristics of dense personnel, high mobility, and concentrated accommodation [10]. There is a natural fit between the student community composed of student dormitory areas and urban and rural communities. With the acceleration of the modernization of China's higher education and the expansion of the scale of running schools, the traditional school management mode and student service measures cannot fully meet the requirements of the new era. The ideological and political work and school

safety and stability work are facing great pressure, which must be solved by promoting modern management methods and using modern information technology.

2.1. Edge Calculation Principle. Aiming at the functional objectives of resource sharing, collaborative work, dynamic adjustment, and high expansion of student dormitory grid management, this paper selects the edge computing method to realize it.

The edge computing model shares the processing tasks of cloud and data link [11, 12], making subsequent maintenance and repair more timely and accurate. The workflow of the edge computing model is as follows: the edge node on the student dormitory grid generates data related to the running state and sends it to the cloud center together with the generated data of the platform. The edge node puts forward a request instruction to the cloud center, which provides the edge node with data about the running state. Therefore, in the grid information integration platform of student dormitory, the edge computing model shown in Figure 1 is adopted.

According to the edge computing model shown in Figure 1, when using edge computing to design the grid information integration platform of student dormitories, first, the source information is centrally matched by means of data matching, and then the data preprocessing is completed. Second, the data are centrally managed through the monitoring and analysis of big data, so as to complete the data fusion processing. The data fusion process is as follows:

- Step 1: check the initialization of the grid information integration platform of the student dormitory;
- Step 2: data buffering and setting each serial port;
- Step 3: initialize and set parameters such as display;
- Step 4: filter the data signal and display the detection result;
- Step 5: data fusion.

Based on the above steps, the following will first analyze the overall design framework of the grid information integration platform for student dormitories. Combined with the functional modular analysis and integrated information processing, the integrated framework of the grid information integration platform of student dormitory is carried out.

2.2. Overall Structure. Based on the above edge computing principle, a grid information integration platform for student dormitory is designed. B/S architecture system [13, 14] is adopted for network control at the client, and the grid information integration platform of student dormitory is established on the grid cross networking structure of student dormitory. Using embedded B/S architecture design method, the modular structure design of grid information integration platform in student dormitory is carried out. VIX bus control technology is used to realize the bus integration of student dormitory grid information integration platform, and the hardware development and design of student dormitory grid information integration platform is

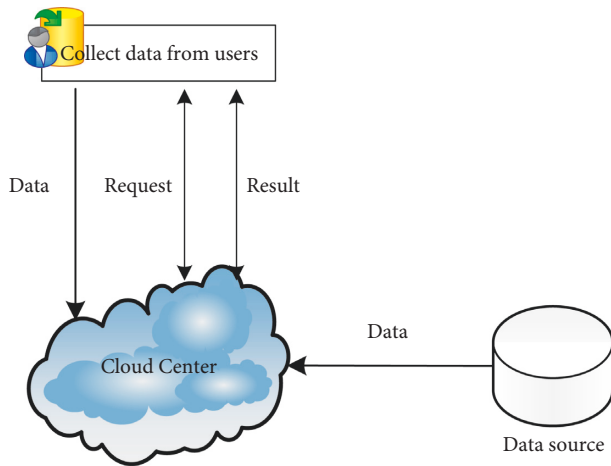


FIGURE 1: Schematic diagram of the edge calculation model.

realized in the integrated processing environment of DSP and FPGA.

B/S structure, i.e., browser/server structure. The structure has the following advantages:

- (1) The maintenance and upgrade of the platform is simple. Most of the business logic is implemented on the server, so the upgrade and maintenance can only be carried out on the server, which greatly reduces the work cost and workload.
- (2) Strong compatibility. Software using B/S architecture has more choices on the operating platform, including Windows, Linux, UNIX.
- (3) Strong interaction. BS architecture can be directly placed on the WAN, and the purpose of multi-customer access can be realized through certain permission control
- (4) High security. The data are centrally stored in the database server of the headquarters. The client does not save any business data and database connection information, and the client does not have to synchronize the data, so the security problem is guaranteed.

Based on the B/S structure, this paper designs the framework of the grid information integration platform of the student dormitory, extracts the dynamic information intelligently monitored by the grid information integration platform of the student dormitory, integrates the grid information of the student dormitory by using the multidimensional information fusion technology, and visually tracks the grid information of the student dormitory by using the visual image processing technology. The platform is divided into information acquisition module, network networking module, program loading module, upper computer communication module, and human-computer interaction module. This paper designs the user control module for input information control, data processing module to carry out the integrated information processing and data analysis of the grid information of the student dormitory, designs the grid information fusion algorithm of

the student dormitory, improves the integrated control ability of the grid information of the student dormitory, and realizes the image display and human-computer interaction of the grid information of the student dormitory in the output module [15]. According to the above analysis, the overall module architecture of the grid information integration platform of student dormitory is shown in Figure 2.

According to the overall architecture of Figure 2, the hardware design of grid information integration platform of student dormitory is carried out.

3. Hardware Design of Grid Information Integration Platform in Student Dormitory

3.1. Central Unit. The central unit is the core of the platform, and its main function is to regulate, control, and manage the operation of the whole platform [16]. The unit is equivalent to a microcomputer. The hardware configuration of the central unit is shown in Table 1.

3.2. Power Circuit. Power supply refers to the circuit of the power supply part that provides power to the platform and is the power source for the operation of the whole platform. The power design of this platform is shown in Figure 3.

3.3. LCD Display. LCD display is the only interactive window for users to connect with the platform. The resolution of the display in this platform is 2880×900 pixels, size 32:10, brightness 200 cd/m², contrast 10000:1, response speed 0.02 ms. Adobe RGB color coverage is 99.3%, and sRGB color gamut is 100%. This platform connects LCD controller, ram, ROM, LCD, and LCD display through PCB to form LCD module [17, 18].

3.4. Signal Processor. Signal processor is the key hardware of information integration. Taking TMS320F2812 chip as the core, this paper deeply analyzes the pin and serial communication mode of the chip and establishes the signal processor infrastructure combined with Harvard bus architecture. The specific structure of TMS320F2812 chip is shown in Figure 4.

According to Figure 4, the signal processor based on TMS320F2812 chip mainly includes four key parts: flash memory, fast analog-to-digital converter, enhanced can module, and multichannel buffered serial port.

3.5. Regulated Power Supply. As the power guarantee hardware of the information integration platform, the power module is the key to the stability of the platform. According to the actual environment of student dormitory, the power supply with amplitude of 5.0 V and 3.6 V is designed in this paper. Combined with the integrated voltage stabilizing circuit lm2576t-5.0, the design of voltage stabilizing power supply is completed. Among them, a voltage regulator with 3 A output current is adopted, relying on the self-protection circuit contained in the integrated voltage stabilizing switch circuit, a small number of external components are added,

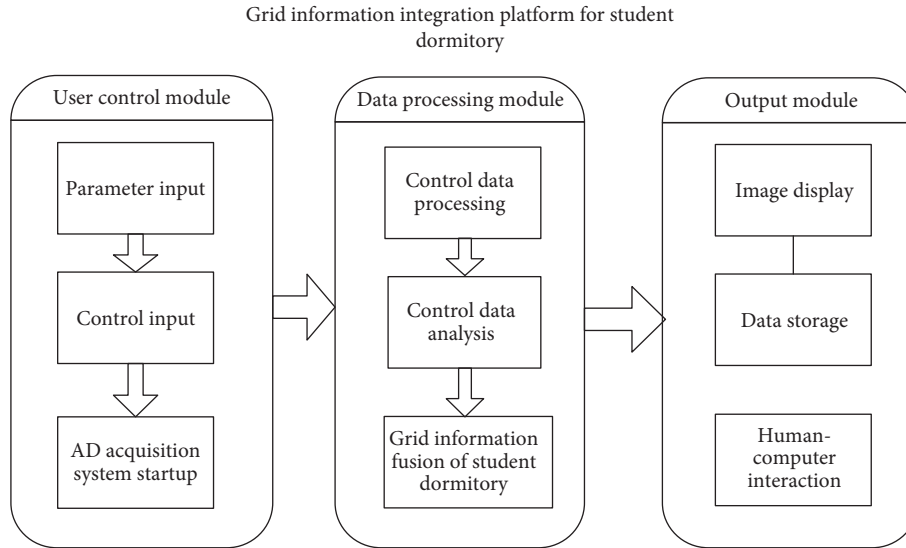


FIGURE 2: Overall module framework of grid information integration platform for student dormitory.

TABLE 1: Hardware configuration of central unit.

Hardware type	Configure
CPU type	Quad core amdpteron8387
CPU frequency	2800 (MHz)
Processor description	Number of standard processors
Number of CPUs supported	8
Processor cache	512 KB per core integrates L2 cache and 6 MB per processor integrates L3 cache
Expansion slot	Three X8 PCI express; four X4 PCI express; 2 PCI-X (100MHz); four PCI-E standard slots are used to install the smart array P400 controller
Memory type	PC2-6400 registered DIMM running at 800 MHz
Memory size	16 GB
Maximum memory capacity	256 GB
Hard disk size	3 * 300 GB SAS hot swap hard disk
Hard disk controller	SAS raid card (CACHE \geq 256M)
Number of internal hard disk racks	\geq 8 hot swappable hard disk slots
CD drive	Ultrathin DD drive (8x/24x)
Network controller	Two embedded nc371i capable gigabit network adapters with TCP/IP offload engine, supporting accelerated iSCSI through an optional license suite
Power	910 W/1300 W
Power type	Two hot swap power supplies are standard
Operating platform support	Microsoft@Windows@Server; Microsoft@Windows@Server Hyper V; Red Hat EnterpriseLinux (RHEL); SUSE Linux Enterprise Server (SLES); Oracle Enterprise Linux (OEL)

and a voltage stabilizing circuit with stable and efficient characteristics is set.

So far, the hardware design of grid information integration platform in student dormitory has been completed.

4. Software Design of Grid Information Integration Platform for Student Dormitory

Grid management transforms the past management mode of passive response to problems into active problem discovery and problem-solving. It has the characteristics of agile, efficient, and accurate management [19] and has internal unity with the concept of crisis prevention management. The construction of campus crisis prevention management system

through dormitory grid management has important practical significance for the management of college students [20]. Since some colleges and universities in provinces and cities took the lead in implementing grid management, colleges and universities in many parts of the country have begun the preliminary exploration of grid management services of student dormitories, formed valuable experience, established a “horizontal to edge” and “vertical to the end” management network, and built a three-dimensional system of crisis prevention and management of student dormitories. The implementation of grid management is conducive to timely and comprehensive grasp of college student information, improve the timeliness, pertinence, and scientificity of student education service management [21] and is an effective way to

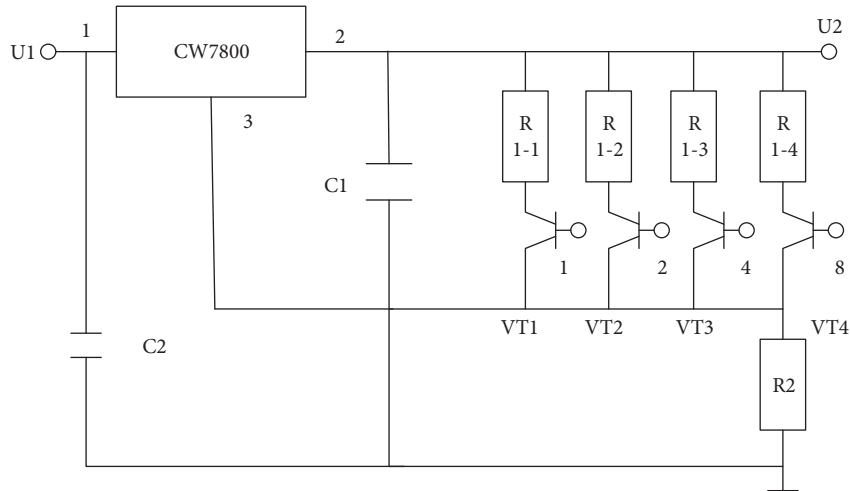


FIGURE 3: Power supply circuit.

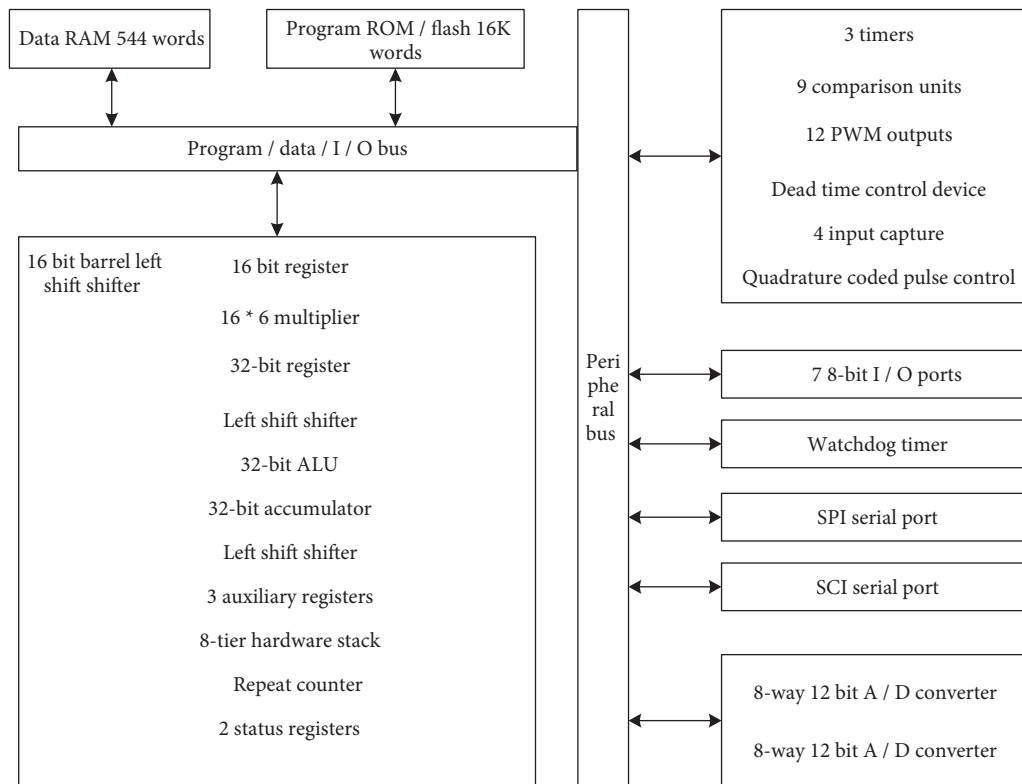


FIGURE 4: Schematic diagram of TMS320 F2812 chip structure.

realize the modernization of College Governance System and governance ability. Therefore, based on the hardware design, the software algorithm is designed to optimize the grid information integration effect of student dormitory.

4.1. *Establish Grid Warehouse of Student Dormitory.* Considering that the main purpose of the design of information integration platform is to integrate all aspects of grid information of student dormitories and assist managers to

establish decision-making schemes. The establishment of data warehouse needs to be based on providing high-level decision support function [22, 23], and then design low-level query function according to the requirements of detailed data statistics. Based on the above integration content, the grid information integration model of student dormitory is constructed by using the three-level mode. The overall design is completed by summarizing the data layer, data operation layer, and data integration layer. The specific design idea is shown in Figure 5.

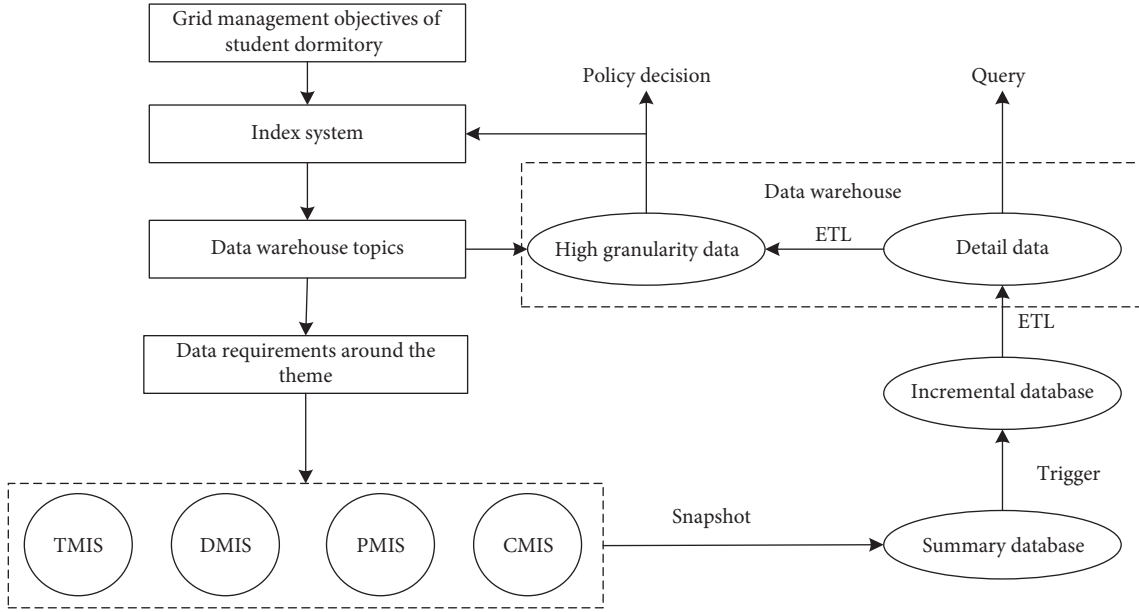


FIGURE 5: Schematic diagram of data warehouse.

According to the schematic diagram of data warehouse shown in Figure 5, high-granularity data storage is the last step in the decision-making of establishing student dormitory, which directly affects the development goal of student dormitory. Relying on the index system, the information required by the main body of the data warehouse is extracted from the grid information of diversified student dormitories. In addition, in order to reduce the computational complexity of data increment, this paper proposes a simple data aggregation mode for business entities and realizes high-granularity data storage around the decision-making theme as the operation basis of the information integration platform.

Considering the diversity of grid information in student dormitories [24], this paper proposes that in the data warehouse, in addition to using the signal processor for preliminary data processing, and then integrating the two-way mapping strategy based on metadata drive, this paper deeply analyzes the mapping rule formula of grid information in student dormitories and converts the data form based on the parsed parameter information. In order to facilitate the data collection and data integration management of the information integration platform, this paper applies the two-way mapping mode to establish the forward mapping and reverse mapping relationship between the source database and the target database. First, define the source data model and target data model as follows:

$$A = \{Q(x, y, z)\}, \quad (1)$$

$$B = \{C(f, g), D(e, r)\}. \quad (2)$$

In formulas (1) and (2), A represents the source data model; B represents the target data model; Q, C, D represent the grid source information of three student dormitories;

x, y, z represent the three attributes of data Q ; f, g represent the two attributes of data C ; and e, r represent the two attributes of data D .

The forward mapping of grid information in student dormitory refers to the mapping from source data model to target data model, which can be expressed as:

$$\alpha = (A, B, \varphi). \quad (3)$$

In formula (3), α represents forward mapping and φ represents forward mapping rules.

Reverse mapping refers to the reverse operation of the forward mapping relationship, that is, converting the target data into metadata. The specific expression is as follows:

$$\alpha^{-1} = (B, A, \phi). \quad (4)$$

In formula (4), α^{-1} represents reverse mapping and ϕ represents reverse mapping rules.

This paper proposes to integrate the two-way mapping strategy into the establishment of data warehouse to realize the effective preservation of student dormitory grid.

4.2. Design Distributed Data Acquisition Technology. The design of data warehouse provides basic conditions for information collection. This paper proposes link data collection mode [25, 26] and designs distributed data collection technology. Adopt appropriate tools to collect the status data of the communication network, preliminarily convert the link information, and then complete the distributed data collection in combination with the principle of distributed structure and management domain. First, according to the region and organization of the student dormitory, it is divided into multiple domains, and a manager is set for each domain. By collecting the information provided by each domain manager, the grid information collection of the

whole student dormitory is completed. The specific form of the distributed collection management model is shown in Figure 6.

The distributed management model shown in Figure 6 mainly adopts the parity structure to allocate the grid collection task of student dormitory to each domain manager. Run the data acquisition technology from the domain head node, set other nodes in the domain as the monitoring host node, and collect the data of the interdomain link through the interaction between the head node of each domain and other domain head nodes. Considering that there are many types of grid in student dormitories, the distributed data acquisition link can be set as wired link and wireless link. In this paper, Ethernet is used to establish wired link, and the corresponding link index measurement method is proposed to clarify the current data acquisition link bandwidth, improve the asymmetric link bandwidth in combination with the actual data acquisition environment, and improve the grid information acquisition accuracy of student dormitories. In this paper, the RI-TAW-PATHCHAR method is used to measure the link bandwidth, and the ICMP echo message used to obtain the message cycle time of the measured packet is given by

$$R = \frac{2sl_m}{u_m} + q_1 + q_2 + q_3 + q_4 + t. \quad (5)$$

In formula (5), R represents the message cycle time, m represents the node, q represents the queuing delay, s represents the length of the measurement packet, u represents the link bandwidth, t represents the processing time of the node for the measurement packet, and l represents the propagation delay. In order to simplify the calculation of formula (5), set the response message as ICMP timeout message, and the calculated message delay time is given by:

$$\eta_m = s \sum_{i=1}^m \frac{1}{u_i} + \sum_{i=1}^m \left(\frac{R}{u_i} + l_i \right). \quad (6)$$

In formula (6), i represents the link segment and η represents the delay time of the response message. The uplink bandwidth can be deduced according to the message delay time:

$$u_m = \frac{1}{k_m - k_{m-1}}. \quad (7)$$

In formula (7), k represents the slope of linear function $\eta_m(s)$. When the response message is set as ICMP reply message, the message cycle delay time can be expressed as:

$$\eta'_m = s \sum_{i=1}^m u_i + l_i. \quad (8)$$

In formula (8), η' represents the delay time of ICMP reply message. Combined with formulas (7) (8), it can be deduced that:

$$u'_m = \frac{1}{(k'_m - k'_{m-1}) - (k_m - k_{m-1})}. \quad (9)$$

In formula (9), k' represents the slope of the linear function $\eta'_m(s)$ and u' represents the downlink bandwidth. According to the calculation results of uplink bandwidth and downlink bandwidth, the link is optimized according to the asymmetric link improvement strategy to effectively improve the anti-interference of grid information collection in student dormitories.

4.3. Build an Edge Calculation Data Query Model. Grid information query of student dormitory is another important content in the design of information integration platform. This paper uses edge computing technology to build an intelligent data query model. Based on the IFB tree index structure, this paper strengthens the data access of the database and uses the edge computing technology to establish a new index structure to promote the index recommendation. The construction of edge computing data query model needs to accurately evaluate the cost of grid information query plan of student dormitory and estimate the query scale.

Considering that the optimization of join order is one of the most important problems in the process of data query, this paper establishes the candidate join order with the minimum cost as the database table and takes it as the optimal query plan. Combined with the heuristic algorithm, the best connection order is extracted, and each time slice is connected through the connection processor. After all time slices are connected, the learning optimizer is used to establish the upper limit confidence interval algorithm to complete the setting of data query search space.

The application of edge computing technology in data query model is based on IFB tree structure. For the data query search space established above, the single value query mode is used to construct the edge calculation data query model. The specific IFB tree diagram is shown in Figure 7.

According to the IFB tree structure shown in Figure 4(b), all leaf nodes in the data query process are in the same layer structure, which contains all keyword information of student dormitory grid. Compared with other data query methods, this paper proposes an IFB tree data query model based on edge computing technology, which can effectively improve the data query efficiency of the integration platform. At the same time, in order to reduce the problem of large time cost in the process of data query, this paper proposes to preliminarily predict the location of query nodes based on auxiliary model, which does not need internal search link, so as to shorten the data query time. During the construction of edge computing data query model, the application of linear interpolation algorithm will not change the structure of IFB tree nor will it affect the theoretical performance of IFB tree data query.

4.4. Realize Grid Information Integration of Student Dormitory. Based on the overall design of the grid information integration platform of student dormitory, the grid information integration processing of student dormitory is carried out.

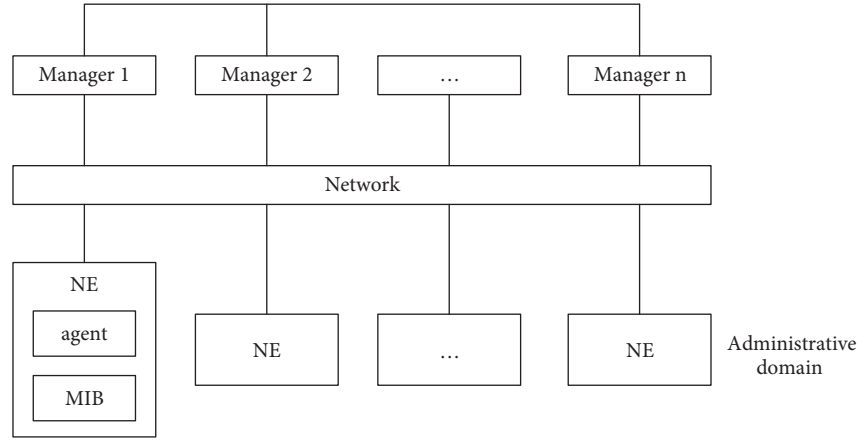


FIGURE 6: Distributed acquisition management model.

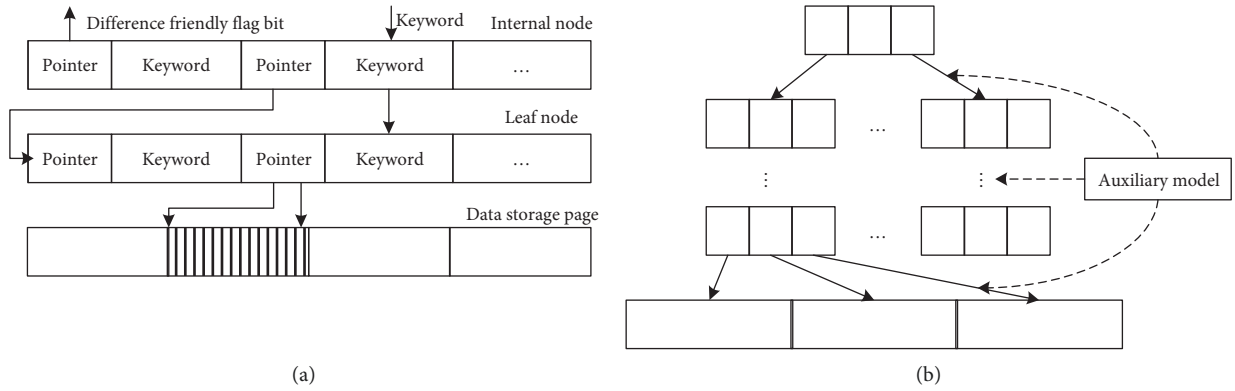


FIGURE 7: Schematic diagram of IFB tree. (a) Difference query (b) Structure diagram.

At present, the data integration of existing clustering integration algorithms mainly depends on the division results of clustering members, which does not have a fixed feature, and the differential characteristics of members are not considered too much in clustering. In actual clustering, members are good and bad, and ignoring these problems will lead to poor clustering results. In view of this phenomenon, further processing is needed to judge the quality of clustering members. Good quality members need to increase their contribution to the clustering results, and poor quality members need to reduce their contribution to the clustering results. The specific processing process is as follows:

Set the initial connection weight in advance, initialize the network before clustering, and randomly assign all connection weights to the value of $[0,1]$ interval. Previous studies have shown that if the input samples of the same network structure are the same, the convergence speed of the algorithm will be faster, and the clustering result will be better. Based on the above contents, the classification of neuron nodes corresponding to the output layer in SOM network is different. For a specific output node, the best sample is output according to formula:

$$d_j = B \sum_{i=1}^m [x_i(t) - w_{ji}(t)]. \quad (10)$$

In the formula, $x_i(t)$ represents the sample data value input at time t , $w_{ij}(t)$ represents the neuron parameter of the i -th data, and B represents the attribute value of the data. In the process of network initialization, due to the large amount of data analyzed, in order to accelerate the convergence speed of the network, the typical sample vector data are processed as the initial weight vector, that is, in the process of sample learning, that is, according to the criterion of Euclidean distance, the approximate probability structure of the input vector is obtained to accelerate the convergence of the network. Based on the above analysis, the weight of cluster members is recorded as follows:

$$w_j^{p,ca} = \frac{\text{Value}^{\cos(\pi)}}{\sum_h \text{Value}^{\cos(\pi)}(\pi_h)}. \quad (11)$$

In the formula, $\text{Value}^{\cos(\pi)}$ represents the evaluation parameter of clustering comprehensive quality, π_h represents the weight given by the h -th data, and $\text{Value}^{\cos(\pi)}$ represents the attribute parameter of the new feature space matrix. Through the above process, the attribute weight weighting required by the new feature space matrix is completed, which provides a prerequisite for data visualization integration.

After the above changes in the grid information feature space of the student dormitory, for the data integration

processing, considering that the attribute importance of each data is different in the new feature space, it is necessary to further calculate the weight of cluster members during processing.

In the iterative process of SOM algorithm, the weighted distance between the input vector and the neuron is used to find the victory neuron, w^{op} is recorded as the attribute vector of the new feature space, and the calculation formula of the distance between the network input vector and the neuron is expressed as follows:

$$K = \sum_{i=1}^m w^{\text{op}} (x_{ik} + \omega_{ij}). \quad (12)$$

In the formula, x_{ik} represents the structure information of data k , and ω_{ij} represents the clustering label of the j -th object.

After the above continuous iterations, the integration results are output, but for some networks, whether the training is completed or not is related to the number of iterations given by the user, which brings a lot of inconvenience to the user. For complex networks and samples, if the given number of iterations is less, it will lead to the termination of training without completing convergence; if too many iterations are given, an overfitting will occur.

In order to better solve the above problems, the convergence criterion of the network is defined to avoid too many or too few iterations.

The learning standard of SOM is the adjustment process of weight vector. Therefore, it is used as the reference parameter to measure the stability of the network. After determining the reference parameter, an energy function $E(t)$ is defined and expressed as

$$E(t) = \sum_{i=1}^k \sum_{j=1}^N [\dot{w}_{i,j}(t-1) - \dot{w}_{i,j}(t)]^2, \quad (13)$$

where $\dot{w}_{i,j}$ stands for learning and updating parameters.

Based on the above process, it can provide basis for calculation iteration, so as to complete the design of grid information integration platform of student dormitory based on edge computing.

5. Experimental Test and Result Analysis

5.1. Test Environment. In order to ensure the accuracy of the experiment, build a test environment before the experiment as shown in Table 2.

5.2. Analysis of Test Results. In the above experimental environment, the grid information integration platform of student dormitory based on edge computing designed in this paper is tested. The test results are shown in Tables 3 and 4.

As can be seen from Tables 3 and 4 above, 300 users sent data to the server concurrently for 3 minutes, and the response time of the server to the event was within 3 seconds, reaching the expected goal; the request success rate is 100%, indicating that 300 users have successfully logged in to the platform; although the resource occupancy rate of the

TABLE 2: Platform test environment.

Testing environment		Name
Server side	Hardware platform	Intel(R)Core(TM)i7-4790 CPU@3.60 GHz.
	Graphics card	NVIDIA geforce GT 705 (1 GB/baolongda)
	A main board	Lenovo sharkbay (intel haswell)
	Operating system	Windows 10 ultimate 64 bit SP1 (DirectX 11)
	IIS server	IIS 7.0
	Programming tools	JavaScript, Microsoft Visual Studio 2013
	Background database	MySQL 5.6.17
Client	Communication bandwidth	4M
	Operating platform	Windows 10
	Browser	Internet explorer
	Communication bandwidth	1M

TABLE 3: Number of concurrent users and transaction execution.

Number of virtual users (PCs.)	Test average response time (s)	Estimated average response time (s)	Average number of concurrent users processed (PCs./s)	Request success rate (%)
25	0.263	0.252	12.36	100
50	0.785	0.782	11.02	100
75	1.036	1.036	10.68	100
100	1.236	1.237	10.22	100
125	1.365	1.368	9.63	100
150	1.523	1.520	9.25	100
175	1.635	1.625	9.14	100
200	1.722	1.725	8.25	100
225	1.782	1.777	8.02	100
250	1.823	1.825	7.23	100
275	1.925	1.936	6.36	100
300	2.425	2.426	5.53	100

TABLE 4: Number of concurrent users and operation of database host (unit:%).

Number of virtual users (PCs.)	CPU utilization	Estimated CPU usage	Memory utilization	Estimated memory utilization
25	13		0.26	
50	15		0.69	
75	18		1.02	
100	22		1.36	
125	25		1.52	
150	27		1.89	
175	30	≤60	2.36	≤5
200	33		3.02	
225	37		3.36	
250	43		4.02	
275	48		4.45	
300	53		4.88	

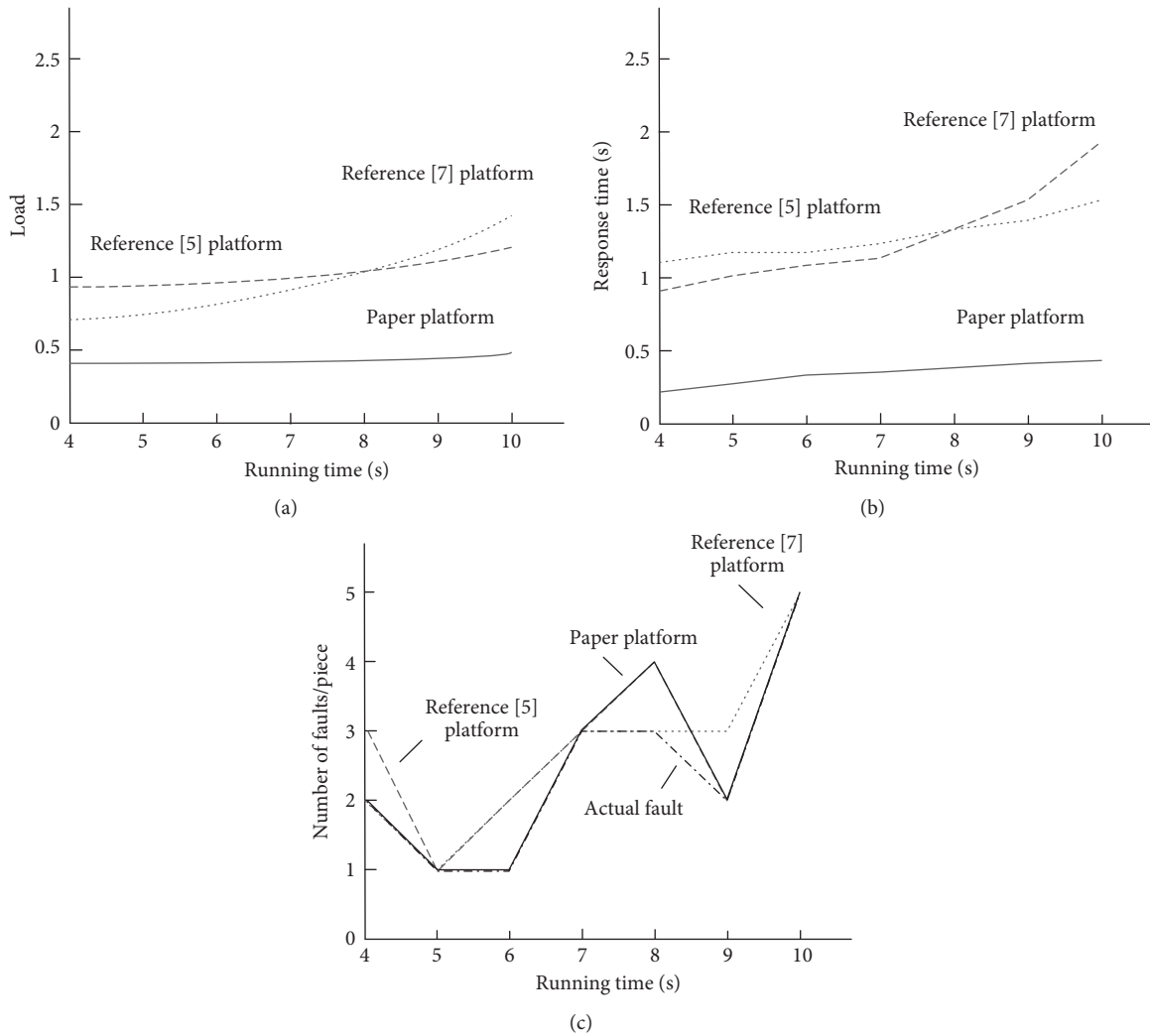


FIGURE 8: Performance test results of different methods. (a) Processor load comparison, (b) comparison of response time of remote monitoring, and (c) comparison of alarm results.

platform increases with the increase of users, it is also controlled within 60%, and the memory usage accounts for less than 5%, which meets the expected performance goal of the platform.

In order to verify the practicality and feasibility of the platform, the platform designed in references [5, 7] and the platform in this paper are used to detect from different angles such as processor load, remote monitoring response time, and accuracy of alarm results. The results are shown in Figure 8.

According to the performance test results of each method shown in Figure 8, the processor load of the designed platform is less than 0.5, the response time of remote monitoring is less than 0.5 s, and the number of false alarms is less than 1 compared with the actual alarm results. Therefore, the platform uses the edge computing model to share the processing tasks of the cloud and the data link, reducing the overhead caused by multiple establishment and cancellation of multithreads, and improving the processing efficiency of the platform. High

priority tasks are handled in real time. Therefore, compared with the literature platform, it not only greatly saves the response time but also makes effective use of the processor time and memory and increases the accuracy of grid fault early warning in student dormitory to a certain extent.

The transmission delay of the three platforms with different frequency band utilization is counted, and the statistical results are shown in Figure 9.

As can be seen from the model test results in Figure 9, the platform in this paper has low transmission delay under different frequency band utilization, and the transmission delay is less than 200 ms. It is verified that the platform in this paper has low transmission delay and good communication performance.

According to the above experimental results, the grid information integration platform of student dormitory based on edge computing designed in this paper has good performance. While ensuring low response time, the transmission delay is reduced.

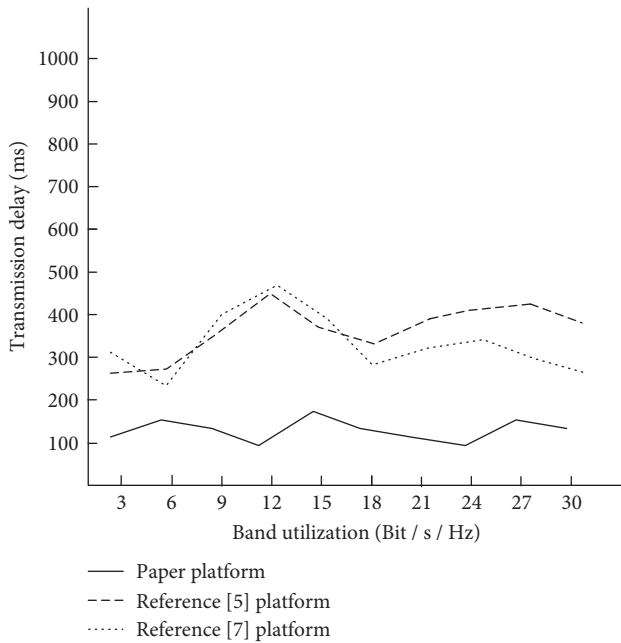


FIGURE 9: Comparison of transmission delay.

6. Conclusion

In order to realize the grid integrated management of student dormitory and avoid the phenomenon of information island, this paper proposes to design a new data integration platform based on edge computing technology. Through the combined design of software and hardware, the overall design of the integrated platform is completed, and the remote monitoring experiment is carried out on multiple student dormitory grids to explore the applicability of the platform. It is necessary to try to adopt more ideal fault detection and prediction methods to fundamentally increase the monitoring quality of the platform. Based on the market demand and video monitoring technology, the improvement of platform video monitoring function should be taken as the research focus in the next stage. The grid domain knowledge of student dormitory should be introduced to strengthen the performance of data acquisition terminal and fill the database to meet the different needs of different users.

Data Availability

The raw data supporting the conclusions of this article can be obtained from the author upon request.

Conflicts of Interest

The author declared that there are no conflicts of interest regarding this work.

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