Mobile Multimedia Teaching System for Ideological and Political Theory Courses Based on Smart Phones

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Abstract. The existing mobile multimedia teaching system for ideological and political theory courses has poor data balance, which leads to excessive communication overhead and affects the overall teaching effect of the system. The mobile multimedia teaching system for ideological and political theory courses is designed based on smartphones. In terms of system hardware design, the Zynq-7000 chip is used as the main control unit to design the ZYNQ core processing module; the high-speed storage circuit is designed to match the acquisition speed and storage speed. In terms of system software design, calculate the load capacity of the gateway, design the teaching system to share the communication network; set the data balance mode of the ideological and political theory course based on the smart phone to shorten the task request delay. Experimental test results show that the communication overhead of the system designed in this paper is significantly less than that of the existing system, the transmission delay range is 30–50 ms, the packet loss rate is less than 20%, and the network load balance can reach 70%, so it is beneficial to balanced multimedia The load capacity of the teaching system reduces link congestion, makes the communication network data transmission more reliable, and is more conducive to the practical teaching system application of ideological and political theory courses.

Keywords: Smart phone · Ideological and political theory class · Mobile · Multimedia teaching system

1 Introduction

Since entering the new century, the Party Central Committee has successively issued a number of documents on further improving and strengthening the ideological and political education of college students. With the continuous renewal and improvement of the student teaching system in the new era, the school pays more and more attention to cultivating students' comprehensive quality capabilities, improving students' psychological qualities, and fully paying attention to the healthy development of students. Ideological and political education, as an important teaching content of students' moral education,

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can guarantee the comprehensive development of morality, intelligence, physical education, and art as students grow up. To a certain extent, ideological and political courses can be said to be one of the innovative results of the reform of ideological and political education courses in colleges and universities in recent years. In order to protect the students' ideological and political ability and improve the traditional ideological and political courses, such as the lack of teaching content and the single education angle, from the perspective of the healthy development of students, the mobile multimedia teaching system is used to combine the education value of ideological and political education for students. Establish correct values. Under the premise of continuous advancement of society, science and technology have also advanced. In this process, mobile smart terminals and mobile Internet usher in new development space. As a brand-new teaching method, multimedia teaching can effectively improve the classroom teaching effect of ideological and political theory in colleges and universities, and stimulate students' learning initiative. In the use of multimedia methods to teach ideological and political theory courses, it is necessary to combine the actual situation of students, grasp the good interest and appropriateness of the ideological and political teaching content, and combine the teaching requirements of ideological and political theory courses to make the multimedia teaching courseware present timeliness and simplicity [1]. In this context, a mobile multimedia teaching system for ideological and political theory courses has gradually been developed and put into use. At this stage, the academic community has carried out extensive and in-depth research on the teaching system, and has achieved certain research results. Literature [2] designed an effectiveness evaluation system for the shortcomings of low evaluation accuracy of the teaching system, which greatly improved the evaluation accuracy. Literature [3] designed and developed a university physics mobile learning platform based on the Android system to free learners from the constraints of time and space. As we all know, smart phones are one of the necessary tools in today's society. People need smart phones in their daily life, study and work. Smart phones have changed people's lifestyles. As long as they are connected to the mobile Internet, they can access information. Access makes people's lives more convenient. With the continuous development of the mobile Internet, people no longer only rely on the original fixed terminal equipment in the process of obtaining information, and are no longer restricted by places, and can consult information anytime and anywhere. Therefore, this paper designs a mobile multimedia teaching system for ideological and political theory courses based on smart phones to improve the teaching effect of ideological and political courses.

2 Hardware Design of Mobile Multimedia Teaching System for Ideological and Political Theory Course

2.1 Design ZYNQ Core Processing Module

The ZYNQ core processing module is the brain of the system. It needs to complete the management of the system's working status, the collection and storage of image data and other scheduling tasks, as well as the communication with external equipment. The main control module receives the control commands of the 422 serial port, sets the working

mode of the camera and feeds its status back to the upper computer. The main control module can also switch between storage function mode and data export mode according to system instructions. In the storage mode, the main control unit can store the collected image data in a fixed format; in the data export mode, the main control unit can read the image data in the storage medium to the host computer through Gigabit Ethernet [4]. According to the current research status at home and abroad, combined with device resources and costs, and according to Xilinx related materials, it is finally determined to use Zynq-7000 series chips as the main control unit. In order to simplify the system code development cycle, the decoder chip is used to decode the LVDS signal of the Cameralink protocol input from the camera. The Cameralink interface can be divided into three types of signals, each of which has a different purpose. The image data signal is the most basic part of the interface. It consists of a set of differential clocks and 4 sets of differential data, and is used to transmit high-precision image data. The camera control signal consists of 4 groups of differential signals, which are mainly used to set the camera's external synchronization, pixel reset, etc. The serial communication signal is composed of 2 groups of differential signals, which can set the camera working mode and configure specific parameters [5]. The decoded data signal contains 3 clock signals, 4 synchronization signals and 80-bit data. A total of 87 I/Os are required for camera control pins (CC1-4). A total of 4 I/Os are required. A set of serial communication signals (SerTFG, SerTC) requires 3 I/Os, 4 serial ports use 8 I/Os and at least 48 I/Os are required for multiple storage solutions selected according to the storage array. In summary, ZYNQ's PL end I/O needs to use at least 150. Considering the quantity and cost of resources, ZYNQ plans to use XC7Z020-CLG484 of Xilix Company. The PL end of the Z7020 uses Artix7, which is highly integrated and can reduce the BOM cost. At the same time, the static power consumption is reduced by 65% compared with the 45 nm device, which has a very wide range of applications.

2.2 Design High-Speed Memory Circuits

According to system performance requirements and functional requirements, in order to ensure that the acquisition speed can match the storage speed, the system is designed to use multiple meters and multiple Micro SD cards to form a storage array. When the SD card uses SDR104 mode, it first needs to be initialized under 3.3 V level signal and switched to work under 1.8 V voltage. After entering the 1.8 V level standard, the mode selection is performed, so the voltage switching function should be provided in the schematic design. The system design uses NVT4857UK to realize the voltage switching function. NVT4857UK is a bidirectional two-level converter, which integrates an LDO module capable of outputting 1.8 V, and uses a 70 K resistor inside the chip to pull the signal line [6]. When the system is powered on, the B2 pin (SEL) is low by default, and the internal pull-up voltage is consistent with the A3 pin (VCC). When the PL terminal pulls the SEL pin high, the internal LDO module starts to work and outputs 1.8 V, which also makes the data pull up to 1.8 V. The system uses 8 Micro SD cards in total, and the circuit design is shown in Fig. 1.

The system design uses SDR104 mode, a single SD card uses 8 PL end I/Os, and 8 SD cards need to use up to 64 I/Os. In order to save system I/O, when all SD cards of the system are initialized, the 8 voltage switching control pins are controlled by the same

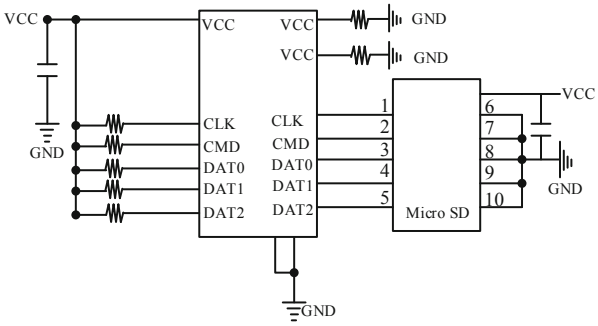

Fig. 1. High-speed memory circuit

I/O, and finally 57 I/Os on the PL end are used. In the core board I/O, the BANK34 and BANK35 pins can change the level standard and each BANK has 50 I/Os, in the design process. In order to ensure the signal quality and the normal and stable operation of the system, all pins of a single SD card are required to use the I/O of the same BANK. So far, the hardware design of the mobile multimedia teaching system for ideological and political theory courses is completed.

3 Software Design of Mobile Multimedia Teaching System for Ideological and Political Theory Course

3.1 Design Teaching System to Share Communication Network

The ideological and political theory course mobile multimedia teaching system shares the communication network. According to the node's video media data and the scheduling information list BM of other nodes, a reasonable client is selected, and the ideological and political theory teaching multimedia information is collected from it. When the user finds the teaching information he needs, he should look it up in the list of other nodes. The information management module mainly updates the management node scheduling list. When the same data module is provided by multiple providers, the provider with the least delay with the node should be selected. If there is no node providing data, the information management module updates the node list to ensure that each data has a provider. When the provider provides more information, the data should be transmitted first to improve the sharing speed of intelligent teaching multimedia resources. The campus network port in the school and other nodes form a network to ensure that users can use other node resources [7]. Different user nodes in the intelligent teaching multimedia sharing network have different functions. When all nodes in the network select one node as the gateway, the network may have a bottleneck. In most cases, the gateway node has the ability to connect to the external network. At this time, the most suitable gateway node should be selected as the gateway to speed up the sharing of intelligent teaching multimedia. Calculate the distance between each gateway node and the fixed node, and judge whether the gateway node is stable according to the distance, and then select the optimal gateway node as the gateway. The weighted average method can be used to

measure the stability of the gateway node, and the formula (1) is as follows.

$$Y_i = \alpha D_{ij} + \beta L_{ij} + \chi P + \delta F + \phi W \tag{1}$$

In formula (1), Y_i represents the node selection factor, and i is used to describe the comprehensive metric that the selected node can be regarded as a gateway. D_{ij} represents the number of hops from gateway node i to node j, and the weight is α. L_{ij} represents the link quality from the gateway node i to the j node, and the weight is β. P_{ij} represents the energy of the gateway node, and the weight is χ. F_{ij} represents the load capacity of the gateway node, and the weight is δ. W_{ij} indicates that the stability weight of the gateway node is ϕ. By comparing Y_i, select the best node that is the gateway. The comprehensive performance of a node is inversely proportional to the selection factor, that is, the smaller the selection factor, the better the comprehensive performance. The load capacity of a node is related to the number of selected nodes as gateways. The greater the remaining load capacity of a multimedia information sharing network node for ideological and political theory teaching, the faster the sharing of multimedia teaching resources. In formula (1), the calculation formula of load capacity is:

$$F = K_i - \sum k_{i,t} \tag{2}$$

In formula (2), K_i represents the total bandwidth of the gateway node. $k_{i,t}$ represents the bandwidth when the gateway node i is selected at t. The calculation of the remaining load is related to time, and the remaining load calculated at different times is different. In order to get a suitable load, it should be smoothed.

$$F = \begin{cases} \lambda F_{i,t} + (1-\lambda)\lambda F_{i,t-1}, & t > 0 \\ K_i, & t = 0 \end{cases} \tag{3}$$

In formula (3), λ represents the remaining load factor, and the value range is between 0 and 1. In order to calculate the stability of the gateway node, the distance from the node to the optimal node in a certain period of time is counted, and the stability of the gateway node is judged by the variance of the distance. The mean value of the distance between node j and gateway node i at time t is:

$$e\left(s_t^{i,j}\right) = \frac{1}{j}\sum_{i=0}^{j-1} s_{t-i}^{i,j} \tag{4}$$

Select the value with the smallest variance, which means that the gateway node at this time is the optimal gateway node, and the optimal gateway node is selected as the gateway exit. Using the node at this moment to access the external network can realize multi-node networked intelligent teaching multimedia resource sharing. And sharing multimedia The speed and precision are high. Integrating the above process, complete the design of the shared communication network of the teaching system.

3.2 Set Up Data Balance Mode for Ideological and Political Theory Courses Based on Smart Phones

Mobile learning based on the smart phone's own functions has limited learning software and learning resources, and has not played its own advantages. In recent years, with

the development of various new technologies such as mobile network technology and wireless network connection technology. The mobile learning model based on external connections is more and more able to play its own advantages and is being widely used [8]. Therefore, smart phones are used as the key nodes of the teaching communication network to ensure the real-time performance of the system and the maximum utilization of resources. First, each smart phone is given the same initial *PR* value, and iteratively updated until the *PR* value stabilizes and the traversal ends. The process can be expressed as:

$$PR(G) = (1-\alpha) + \alpha\left(\frac{PR(H_1)}{N(H_1)} + \cdots + \frac{PR(H_i)}{N(H_i)}\right) \tag{5}$$

In formula (5), $PR(G)$ represents the PageRank value of smart phone G; α represents the attenuation coefficient; H_i represents the web pages connected to G; and N represents the number of web pages connected to G. The Google matrix is constructed by the *PR* values of each webpage, and its iterative method can be expressed as:

$$GO = \omega S + \frac{1-\omega}{n} EE^T \tag{6}$$

$$PR^{(k+1)} = G^T PR^k \tag{7}$$

In formula (6–7), GO is the n-order Google matrix; S is the adjacency matrix constructed by connection; ω is the damping coefficient; E is an n-bit column vector with all 1 elements; k is the number of iterations. The communication network node of the teaching system can be regarded as a web page, and the link can be regarded as a connection. Therefore, the PageRank algorithm can be used to rank the positioning nodes of the communication network of the teaching system and identify the key nodes with influence. The communication load reflects the operation mode of the communication network. Under the premise of the same topology, different load distributions result in different importance of nodes. Therefore, it is necessary to consider the influence of communication load on node identification. The greater the load capacity, the higher the importance of the node [9]. The load level also reflects the node's requirements for power communication. Under the same scale, the higher the level of load, the greater the communication failure and loss caused by the load. Considering the node load capacity and level comprehensively, the node importance index I_x is obtained, which can be expressed as:

$$\begin{cases} I_x = \theta_1 \bar{I}_{1,x} + \theta_2 \bar{I}_{2,x} \\ \bar{I}_{1,x} = \dfrac{I_{1,x} - \min(I_{1,x})}{\max(I_{1,x}) - \min(I_{1,x})} \\ \bar{I}_{2,x} = \dfrac{I_{2,x} - \min(I_{2,x})}{\max(I_{2,x}) - \min(I_{2,x})} \end{cases} \tag{8}$$

In formula (8), $I_{1,x}$ represents node load capacity, $I_{2,x}$ represents node load level, $\bar{I}_{1,x}$ and $\bar{I}_{2,x}$ distributions represent normalized load capacity and level results; θ_1 and θ_2 represent

weighting factors. According to the communication network structure and operating state of the initial teaching system, calculate the node load, consider the importance of the nodes, and obtain a stable *PR* matrix through the power method iteration. The larger the element *PR* value in the matrix, the higher the importance of the corresponding node, and it can be identified It is a key node. By identifying key nodes, it can help adjust the load strategy of the entire teaching system communication network, and adjust and optimize the communication load flow [10]. Set the campus website as the main station and the smart phone as the sub-station. The two are abstracted together as node set A, the communication channel is abstracted as link set B, and the defined constraint condition is C, then the ideological and political course teaching system can be expressed as (A, B, C). The task request in the mobile multimedia teaching of the ideological and political theory course is set as d, including (source node, target node, bandwidth), and the transmission delay and link utilization rate of the teaching task request are comprehensively considered to construct the objective function. The routing objective function can be expressed as:

$$f(d) = \min\left(\sum_{d \in D} \alpha T_d + \beta\kappa\right) \tag{9}$$

In formula (9), α and β are constant coefficients; D represents the set of teaching task requests; T_d represents the communication delay; κ represents the maximum link utilization. Among them, the calculation formula of communication delay T_d is:

$$T_d = \frac{l}{v} a_{dl}^{xy} + bt_u + \Delta t \tag{10}$$

$$b = \sum_{(x,y) \in B} a_{dl}^{xy} \tag{11}$$

In formula (10–11), l represents the length of the path; v represents the transmission speed of the information channel; a_{dl}^{xy} represents the l-th service flow and the d-th path through the link l_{xy}, when it passes through a_{dl}^{xy}, it is 1, otherwise it is 0; b represents the a_{dl}^{xy} Set; t_u represents node switching delay; Δt represents delay jitter. The formula for calculating the maximum link utilization rate κ is:

$$\kappa = \max\left(\sum_{d=1}^{D} \frac{a_{dl}^{xy} Q_{dl}}{L_{xy}}\right) \tag{12}$$

In formula (12), Q_{dl} represents the path flow; L_{xy} represents the link capacity. The constraint conditions for the above-mentioned routing objective function are:

$$\begin{cases} \sum\limits_{(x,y) \in B} a_{dl}^{xy} - \sum\limits_{(y,x) \in B} a_{dl}^{yx} = 0 \\ \sum\limits_{(y,x) \in B} a_{dl}^{xy} Q_{dl} \le L_{xy} \cdot \kappa \end{cases} \tag{13}$$

The above conditions indicate that (1) the total inflow of nodes is equal to the total outflow; (2) the routing load needs to meet the maximum link load constraint. Using smart phone data balance adjustment to minimize the task request delay and link utilization additive measurement, to ensure the real-time performance of the teaching system and maximize the use of resources. Through the construction of the above hardware and software parts, the design of the mobile multimedia teaching system for ideological and political theory courses is completed.

4 Experimental Study

4.1 Teaching System Communication Function Debugging

Communication performance is an important part of the system. First of all, the communication image of the teaching system is debugged. If the debug result does not reach the set goal, the mobile multimedia teaching system cannot be applied to the teaching of ideological and political theory. This will not only improve teaching efficiency, but will reduce efficiency. Therefore, communication performance debugging must be carried out before deployment, and the mobile multimedia teaching system can be deployed to the school on the basis of performance debugging results in accordance with the requirements and goals. Select two indicators of transmission delay and packet loss rate to test the application effect of the communication function. The transmission delay test result is shown in Fig. 2, and the data packet loss rate test result is shown in Fig. 3.

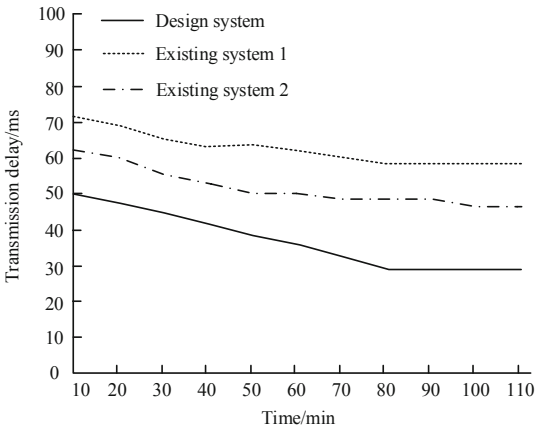

Fig. 2. Comparison results of transmission delay

According to the comparative test result in Fig. 2, the transmission delay of the designed system and the existing system will decrease with the increase in running time. And it converges when it runs for 80 min. The transmission delay starting point and convergence point of the system in this paper are lower than the existing system. The transmission delay is in the range of 30–50 ms, and the rate of decline is relatively

fast, showing a rapid decline trend, indicating that the system designed in this paper is superior to the existing system in terms of data transmission time, and can quickly and effectively reduce the data transmission delay. Therefore, the identification of key nodes is accurate, which is beneficial to balance the load and reduce link congestion.

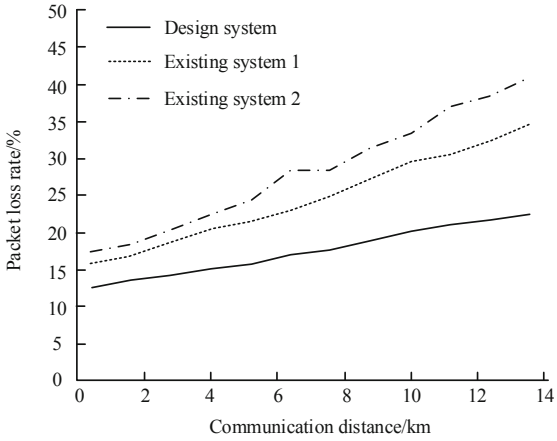

Fig. 3. Comparison results of packet loss rate

According to the comparative test results in Fig. 3, the data packet loss rate of the system designed in this paper and the existing system increase with the increase of communication distances. Compared with the existing system, the data packet loss rate of the system in this paper is relatively low, at 20%. Below, the growth rate is relatively slow. It shows that the method in this paper identifies key nodes, adds routing strategies for alternative paths, expands the search space, and helps to balance the load. Even if the logical link is interrupted in the dynamic changes of the network, the success rate of data packet delivery is relatively high, and the data transmission of the communication network is relatively more reliable.

4.2 Evaluation of Teaching System Data Balance

To test the data balance effect of the teaching system designed in this article, test the load balance of the communication network of the teaching system. Calculate the load of each path through the key node, set the load capacity of the node as the balance index of the node, and evaluate the balance index of the key node identified by the system and the existing system to detect the effect of data load balancing. The specific test results are shown in Table 1.

According to the test results in Table 1, the key node positions obtained by this system and the existing system are different. But in terms of load balancing index, the key node load index obtained by the system in this paper is higher than that of the existing system. Further test the overall load balance of the communication network of the teaching system, and the results are shown in Fig. 4.

Table 1. Key node load comparison test

Sort	Design system		Existing system 1		Existing system 2	
	Serial number	Equilibrium index	Serial number	Equilibrium index	Serial number	Equilibrium index
1	33	90.8	15	90.2	34	80.8
2	18	90.3	18	80.8	37	80.6
3	12	80.6	37	80.5	29	70.9
4	32	80.4	11	70.8	31	70.5
5	25	80.2	22	70.4	16	60.9
6	11	70.9	21	70.2	24	60.4
7	17	70.5	9	60.9	17	50.8
8	8	60.8	20	60.5	26	50.3
9	15	60.4	14	50.4	4	40.7
10	26	50.8	16	40.9	12	30.6

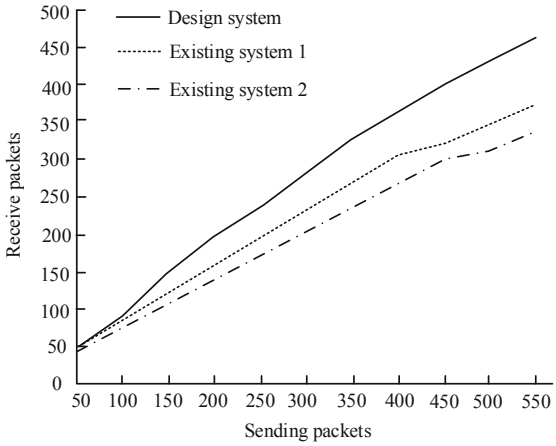

Fig. 4. Load balance comparison results

The communication status of the communication network link of the teaching system is compared, and the number of data packets sent and received is tested. According to the comparative test results in Fig. 4, at the stage when the network load is small, the load transmission and reception balance of the system in this paper and the existing system are relatively close; as the network load increases, the data reception of the existing system grows slowly. The system growth trend in this paper is fast, and the network load balance can reach 70%. It shows that the network load balance of the method in this paper is better than the traditional method. The data packet transmission and reception of

the communication link are relatively flat, and the link congestion is less. In the teaching system.

4.3 Teaching System Communication Overhead Test

System communication overhead testing is an efficient distributed testing behavior. It is calculated that the teaching system changes as the number of concurrent users increases. In the network parallel computing system, the network communication overhead is an important factor that affects the operating efficiency of the network system. The running time and the communication overhead between computing nodes have an important impact on the design of the teaching system. However, network communication overhead contains many factors. This article uses a timing tool with an accuracy of 0.1 microseconds to measure and record the number of nodes that need to be updated when users participate and exit, compare and measure communication overhead, and compare the communication overhead of user participation under different systems. The value of the test result is shown in Tables 2 and 3.

Table 2. Comparison results of communication overhead when users participate

Number of concurrent users	Communication overhead (bits)		
	Design system	Existing system 1	Existing system 2
50	160	210	200
100	210	240	230
150	240	270	260
200	280	310	290
250	300	340	340
300	340	370	360
350	380	420	390
400	420	460	470
450	460	480	490
500	480	500	510
Average value	327	360	354

From the test results in Tables 2 and 3, it can be seen that the communication overhead of the system designed in this paper is significantly less than that of the existing system. The communication overhead is reduced by 33 bits and 27 bits when the user participates, and the communication overhead is reduced by 50 bits and 53 bits when the user exits. When a user participates or exits, different nodes may be affected multiple times, and as the number of users grows, the amount of communication increases accordingly. The data balance of the system designed in this paper is better, and the data redundancy is reduced, so the communication overhead is small and it has certain advantages.

Table 3. Comparison results of communication overhead when users log out

Number of concurrent users	Communication overhead (bits)		
	Design system	Existing system 1	Existing system 2
50	170	210	230
100	200	250	260
150	230	270	280
200	260	300	320
250	280	330	330
300	300	360	350
350	320	380	370
400	350	400	410
450	370	430	420
500	410	460	450
Average value	289	339	342

5 Concluding Remarks

The multimedia teaching system can play a guiding role in the mobile teaching planning of ideological and political theory classrooms. This article effectively improves the poor data balance of the traditional multimedia teaching system by constructing the system main control unit and the calculation gateway load capacity, resulting in excessive communication overhead. Big question. This research is based on a smart phone to design a mobile multimedia teaching system for ideological and political theory courses, which is conducive to the improvement of the system's balanced load capacity and reduces link congestion. At the same time, key nodes can be selected efficiently, alternative paths can be added, search space can be expanded, and the overall teaching effect of the ideological and political system can be improved. However, due to limited time and research conditions, the system designed this time still has shortcomings, and the results still have limitations. For example, only one school was selected as the experimental object in this study, and the data lacked universality. Therefore, in the subsequent experiment selection, we can go deeper and make multi-dimensional choices. At the same time, data security technology can be applied to the teaching system to further improve the privacy security of the system and provide more reliable teaching methods for the study of ideological and political theory courses. This will consolidate the results of this experiment and provide theoretical support for the design of multimedia teaching systems in the future.

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