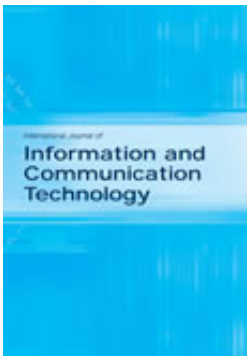

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Online distance music teaching platform based on Internet Plus

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Online distance music teaching platform based on Internet Plus

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Abstract: In order to overcome the low response speed and security problems of traditional music teaching platform, a new online distance music teaching platform based on Internet Plus is proposed. Based on Internet Plus, online distance music teaching server and online distance music teaching client is designed to complete the hardware design of the platform. Through the construction of students' personalised learning evaluation model and online distance music teaching program, the software design of the platform is completed. Combined with the platform's hardware and software, the design of online distance music teaching platform is realised. The experimental results show that online music teaching platform based on Internet Plus can shorten response time, and the response time is only 290 ms, which greatly improves the security of the platform.

Keywords: Internet Plus; online education; music teaching platform; evaluation model.

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1 Introduction

Music courses and the Internet Plus are integrated together to provide a theoretical basis for the internet development of music courses. There are sparks between music courses and internet technology, and the integration ideas between internet technology and various courses of music major burst out (Miao et al., 2019; Xie et al., 2020; Chen and Wu, 2020). This paper attempts to apply the internet to music teaching to provide a new theoretical reference for the innovation and promotion of music professional courses. In the field of music education and teaching, the combination of internet and education has become the main way of today's education development. Compared with the traditional music teaching methods, music teaching based on the internet has completely realised the transformation of education quality. Online education and teaching through the internet can effectively solve the problem of insufficient educational resources. At the same time,

it can also realise the data sharing of music education and teaching resources, breaking the limitation of the original education mode on space, so that every student can obtain more music learning resources and improve the flexibility of students in music learning (Du et al., 2018; Fenu et al., 2017; Feng et al., 2020). Nowadays, internet education has become the main teaching method of domestic universities and educational institutions. Under the background of the rapid development of computer technology, the sharing of education and teaching resources will become the main development trend of internet education.

Zheng and Ge (2017) propose an online and long-distance music teaching platform based on internet mobile terminal. The design idea of general teaching resource sharing platform is collected from the internet by using topic search technology. With the help of internet mobile terminal, more efficient general teaching resource service is provided for users, and the problems of single source and poor update power in the construction of general teaching resource library are avoided. It improves the utilisation rate of general resources and reduces the waste of human resources, financial resources and material resources in the repeated development process of general teaching resources, but the security of the platform still needs to be further improved. Liu and Guo (2017) propose an online long-distance music teaching platform based on electronic 3D virtual reality. In order to improve the intelligent control and visual sensory characteristics of flipped classroom distance teaching, the software of distance teaching system is designed in the electronic 3D virtual reality environment, and the flipped classroom distance teaching simulation was carried out. The 3D teaching scene model of flipped classroom is established, and the 3D visual development technology is combined. The simulation program of flipped classroom distance teaching is established to realise the design of flipped classroom distance teaching system. The results show that the visualisation effect of the system is better, but the response speed of the platform is low. Xia et al. (2017) propose an online distance music teaching platform based on the information network model. By analysing the concept of micro class mobile learning, a micro class mobile teaching system supporting smart phones is designed. The system integrates video annotation, intelligent promotion and smart phone development. Students can access the micro class video at any time to obtain better micro class mobile teaching information. The mobile teaching system can obtain the statistical results of micro class mobile analysis, but the security of the platform is poor and vulnerable to malicious attacks.

In order to solve the problems of long response time and poor security, an online distance music teaching platform based on Internet Plus is proposed. The overall research method of the platform is as follows:

1 Considering the application requirements of the platform based on the Internet Plus environment, the distance music teaching server and the distance music teaching client are designed, and the hardware design of the platform is completed through the above process.

2 In the software part, the model of students' personalised learning evaluation is built, and the distance music teaching program is designed. The software design results are combined with the hardware part to complete the overall research of the platform.

3 The response time and security are taken as the experimental comparison indexes, and the designed platform is compared with the platforms in Zheng and Ge (2017) and Liu and Guo (2017).

2 Research on online distance music teaching platform based on Internet Plus

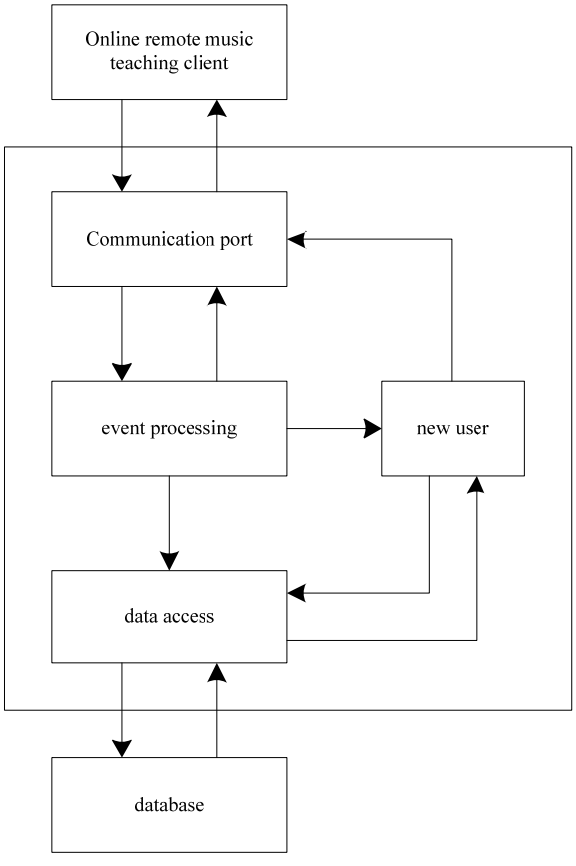
2.1 Hardware design based on Internet Plus platform

In order to improve the application performance of online distance music teaching platform, the hardware of the platform is designed. Taking security and efficiency as the hardware design principles, the hardware of the teaching platform mainly includes online remote music teaching server and online remote music teaching client.

2.1.1 Design of online distance music teaching server

The structure of online distance music teaching server is shown in Figure 1.

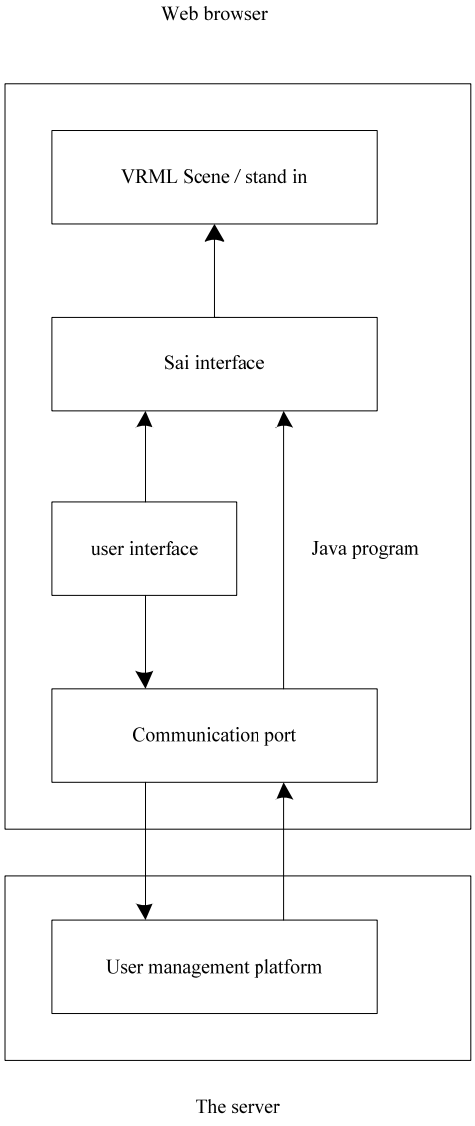
Figure 1 Structure of online distance music teaching server



When the online distance music teaching server receives events from the client, it will check whether the logged in user belongs to the newly registered user in advance. If it does not belong to the newly registered user, it will transmit the received event to all users in the virtual scene and store the information in the database (Ma et al., 2018; Liu et al., 2018); if the login user does not belong to the newly registered user, read the database

first, then the server transmits the user's access information again to all users in the virtual scene.

Figure 2 Client structure of online distance music teaching



The implementation process of the server is as follows: The server side of remote music teaching on line makes the corresponding port, initialises the server, listens to the port to wait for each client to apply for connection request, the client application connection judgment command is established (Wei et al., 2019). Whether the instruction is a new instruction is judged. If it is a new instruction, it will send the update instruction to the online distance music teaching client; otherwise, continue to judge whether the established instruction is a date instruction; if it is a date instruction, it will send the

update instruction to the online distance music teaching client; otherwise, it will continue to judge whether the instruction is a del instruction; if it is a del instruction, it will send an update instruction to the online distance music teaching client. The music teaching client sends the update instruction, otherwise it can be considered that the instruction is undefined and continues to monitor (Chen et al., 2019).

2.1.2 Design of online distance music teaching client

The client structure of online distance music teaching is shown in Figure 2.

When users enter the virtual scene of the platform, they can control their alternative behaviour through mouse control or keyboard control. If the platform thinks that the user's behaviour is correct, it will transmit the user's behaviour to the online distance music teaching server through the communication port, otherwise, it will wait for the user to input the information again (Zhai et al., 2020). Through SAI, the user's input information changes his avatar status. When the client receives information from the online distance music teaching server, users can see changes in other users' behaviour or avatars in the browser.

Based on the structure of the online distance music teaching server, the implementation process of the online distance music teaching server is designed. Based on the structure of the online remote music teaching client, this paper designs the realisation process of the online remote music teaching client, completes the design of the online remote music teaching client, and realises the hardware design of the online remote music teaching platform (Chen et al., 2018).

2.2 Platform software design

2.2.1 Construction of students' individualised learning evaluation model

The design of online music teaching platform based on Internet Plus is mainly based on the different learning characteristics of different students, and customised a set of personalised service design ideas. In personalised service design engineering, the extraction and analysis of students' personality characteristics is the most important way to express. Through the analysis of the results, the online distance music teaching platform will develop an appropriate teaching method for each student (Bai et al., 2018). Therefore, before constructing the evaluation model of students' personalised learning, it is necessary to analyse the students' personality characteristics. The specific analysis process is as follows.

Suppose that the original data of students' personality characteristics is $X = \{x_1, x_2, \cdots, x_m\}$ is the mapping function, and there is $\sum_{k=1}^{M} \phi(x_k) = 0$ at the same time, then the calculation formula of covariance matrix of students' personality characteristics is as follows:

$$C = \frac{1}{M} \sum_{j=1}^{M} \phi(x_j) \phi^{\mathrm{T}}(x_j) \tag{1}$$

In formula (1), M represents the number of original data, and x_j represents some original data.

According to the analysis principle of students' personality characteristics, the covariance matrix of students' personality characteristics is processed:

$$\lambda = Cv \tag{2}$$

In formula (2), v represents the student's personality vector.

According to formula (2), the following results are obtained:

$$\lambda\left(\phi\left(x_k\right), v^r\right) = \left\langle \phi\left(x_k\right), Cv^r \right\rangle, \quad k = 1, 2, \cdots, M \tag{3}$$

In formula (3), v^r represents the combination of mapping function $\phi(x)$, and the calculation formula is as follows:

$$v^r = \sum_{i=1}^{M} c^r \phi\left(x_i\right) \tag{4}$$

In formula (4), c^r represents the vector of personality characteristics.

By introducing the kernel function $k_{ij} = \left\langle \phi\left(x_i\right), \phi\left(x_j\right) \right\rangle$ and considering the formula (1)~formula (4), the following results are obtained:

$$M\lambda^r = Kc^r \tag{5}$$

Suppose that the student's personality feature vector greater than 0 is c^p c^{p+1},..., c^M and the normalisation of c^r will produce $M\lambda\left\langle c^r, c^r \right\rangle = 1$, the following results are obtained through projection:

$$g\left(x_i\right) = \phi\left(x_i\right) - \frac{1}{M}\sum_{i=1}^{M} \phi\left(x_i\right) \tag{6}$$

Suppose that the component of the mapping function $\phi(x)$ is $g(x) = [g_1(x), g_2(x), ..., g_l(x)]^T$.

The projection of the new sample is as follows:

$$g(x) = \left\langle v^r, \phi(x) \right\rangle = \sum_{i=1}^{M} c^r K_1\left(x_i, x\right) \tag{7}$$

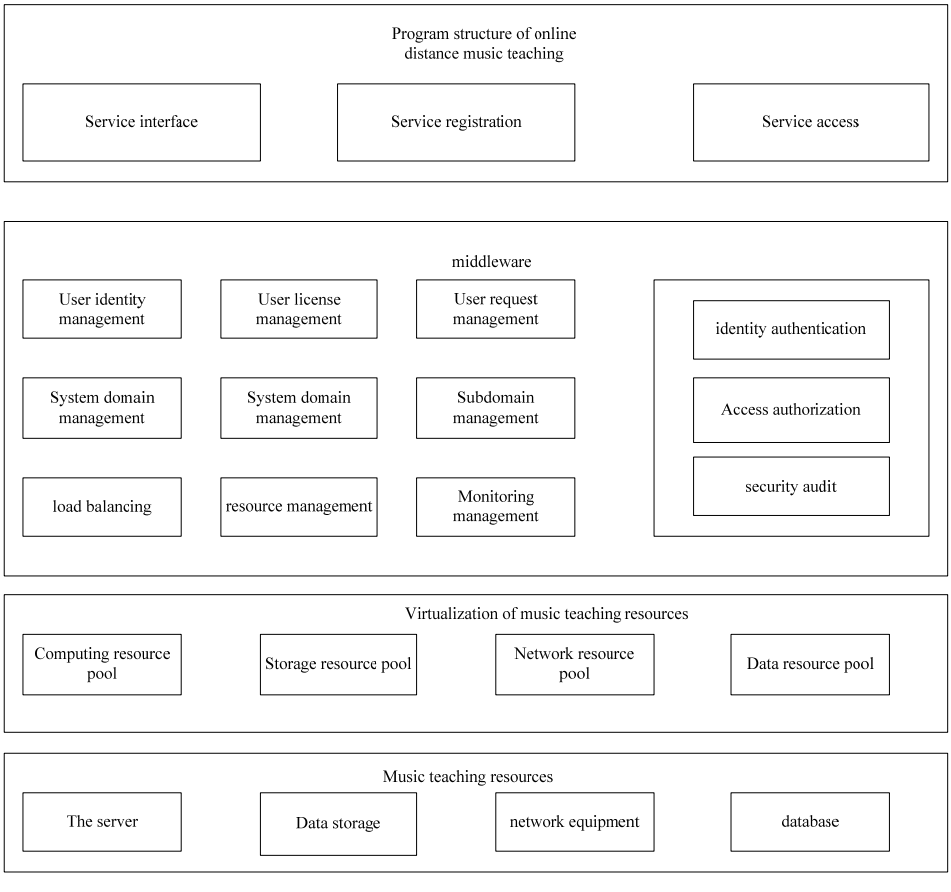
The historical records and knowledge items that students want to learn are put into the internet for training. After the evaluation of students' learning situation, the personalised learning evaluation model of students is constructed.

2.2.2 Online distance music teaching program design

Online distance music teaching program is mainly for online distance learning students to provide diversity and real-time music course learning. Online distance music teaching program can involve distance video teaching, online demonstration, online examination and online answering (Lu et al., 2019). The above functions can improve teaching efficiency in the way of teaching program (Peng et al., 2020). In the online distance music teaching program, students can use different terminals to access the platform, so that the online distance music teaching platform can provide a variety of different forms

of music teaching demonstration services for students and teachers on the basis of the program (Wang et al., 2019). The structure of online distance music teaching program is shown in Figure 3.

Figure 3 Program structure of online distance music teaching



The structure of online distance music teaching program is carried out through different components and interfaces. Customers in the online distance music teaching platform provide interface services through the structure of online distance music teaching programs to adjust the internal middleware services and provide services in the form of domain (Liu, 2018).

To sum up, based on the Internet Plus, the personalised learning assessment model of students is constructed by analysing the personality characteristics of students. Combined with online distance music teaching program design, the software design of online music teaching platform is realised.

3 Experimental verification

In order to verify the designed online distance music teaching platform based on Internet Plus, it needs to conduct comparative verification experiments.

3.1 Test environment

Based on the Internet Plus, the testing environment of online music teaching platform should be appropriately configured according to the actual situation of testing work, and the design requirements of hardware and software should also meet the requirements. The platform test environment is shown in Table 1.

Table 1 Platform test environment

Test category	*Name of test equipment*	*Equipment model*	*Equipment configuration*	*Number*
Hardware configuration	Music teaching server	PowerEdgeT110	2.4 G/8 G, 2 × 500 G	2
	PC terminal		2G/2 G, 1 × 200 G	5
Software configuration	Database	SQL SERVER2008		1
	IE browser			
	IIS	7		1
	Operating system			1
	NET framework			1
Network configuration	broadband	2 M optical fibre		

3.2 Test process

The test of online distance music teaching platform is carried out according to the specific implementation plan of the platform test in the test working time. The scope of the platform test is all the functional modules of the online distance music teaching platform. On the basis of building the platform test environment, all the applications in the platform are deployed to the built test environment. According to the specific content of the test case, each function of the platform is tested, the platform running problems and internal problems found in the test process are recorded, and the problems existing in the platform after the test of each function module are analysed, to find out the specific causes of each problem for correction. After the completion of the revision, the regression module is tested on the functional modules of the online distance music teaching platform based on Internet Plus.

After the completion of the functional module test, performance testing is carried out. The performance test of the online distance music teaching platform based on Internet Plus is mainly to verify the response speed and stability of the platform in the process of increasing the number of users concurrently, increasing the number of users concurrently and the fatigue operation of the platform. After the platform test, in the case of 150 concurrent users, the average response time of the online music teaching platform based

on the Internet Plus is 340 ms, so as to achieve the performance requirements of online music teaching platform based on Internet Plus.

3.2.1 Teacher module

Teacher registration:

Table 2 Teacher registration form

Applicable users	*Teacher*				
Input item description	Name	Length	Type	Constraint	
	Mail box	1~100	Character	A	Legal email address.
				B	Internet Plus based online distance music teaching platform information notification address
	User name	8~100	Character	A	Cannot contain special characters.
				B	You can't start with a number
	Full name	1~100	Character	Only Chinese or English letters can be used	
	Password	10~20	Character	Encrypted and stored in the database	
Function name	Teacher registration				
Function description	1 After the teacher enters the user name and password into the registration page of the platform, the online distance music teaching platform will judge the identity of the teacher according to the platform requirements, and determine whether the teacher to be registered has the registration conditions. 2 After the teacher completes the identity registration, the name and password used in the registration can be changed at any time, but the user name is locked for a long time and cannot be modified. 3 The user must use a valid email address in the registration process, and then activate the user's identity. At this time, the user is in the active state in the platform. Otherwise, any operation of the user in the platform will be prohibited, and the platform will make the user in the disabled state by default.				
Test result	Adopt				

Teachers set up courses:

Table 3 Courses offered by teachers

Applicable users	*Teacher*				
Input item description	Name	Length	Type	Constraint	
	Task	/	Character	A	Free text in the curriculum does not limit the length of the text
				B	At least one assignment should be assigned at the end of each session

Table 3 Courses offered by teachers (continued)

Applicable users	*Teacher*			
Input item description	Name	Length	Type	Constraint
	Chapter	/	Character	A Each chapter must have a number and a title
				B Free text does not limit text length
				C Allow embedded script code within chapters
				D You can upload videos in each chapter
	Course time	19	Date	A The specific format of class time is set as****-**-**
	Course time	19	Date	B The course starts later than the current time shown in the platform
				C The end time of the course is later than the current time of the platform
	Course name	10~100	Character	A The course name under the same user cannot be duplicate
				B Cannot contain special characters
	Course summary	100~1000	Character	The course summary must contain two or more keywords
Function name	Curriculum			
Function description	1 Teachers input the course name, start time and end time into the platform, and add new courses to the total number of courses.			
	2 Each course is divided into several chapters, and an assignment is arranged for students after each chapter.			
	3 Students must wait until the course compiled by the teacher is released before selecting courses.			
	4 If the uploaded courses need to be improved, teachers can modify the specific contents of the courses online at any time. However, if the courses uploaded to the platform are registered and selected by students, teachers cannot modify or delete them again.			
	5 After the examination, the platform will mark each course as completed.			
	6 If the course that students have studied is marked as completed and qualified by the teacher, students cannot register and choose any more courses.			
	7 Teachers can copy the old course content in the platform into the new course content. In the process of copying, the online distance music teaching platform will prompt the teacher whether to copy the test content together.			
	8 Only unpublished courses and unregistered courses can be deleted in the online distance music teaching platform.			
Test result	Adopt			

3.2.2 Student module

Student registration:

Table 4 Student registration form

Applicable users	*Student*				
Input item description	Name	Length	Type		Constraint
	Mail box	1~100	Character	A	Email address must be legal
				B	The platform informs users of the address in the form of information
	User name	8~100	Character	A	Cannot contain special characters
				B	Cannot start with a number
	Full name	1~100	Character	English letters or Chinese only	
	Password	10~20	Character	Encrypted and stored in the database	
Function name	Registration and customisation				
Function description	1 After the students input their user name and password into the online distance music teaching platform, the platform will judge the real identity of the student according to the preset options and identity verification rules, and determine whether the student can register in the teaching platform. 2 After successful registration of student identity and account number, only the name and password used in registration can be modified, but the user name already set cannot be modified. 3 The email address used by students in the process of identity registration must be real and effective. After registration, students must log in to the mailbox and activate the account. At this time, the user in the online distance music teaching platform will be in the active state. Otherwise, any operation of the user in the platform will be prohibited, and the platform will make the user in the disabled state by default. 4 After the students complete the above operations, the platform can customise the corresponding learning methods, interfaces and courses for each student according to the actual situation of the students, and modify them at any time.				
Test result	Adopt				

Students' course selection:

Table 5 Selection of courses

Applicable users	*Student*			
Input item description	Name	Length	Type	Constraint
	/	/	/	/
Function name	Choose a course			
Function description	1 In the online distance music teaching platform, it can select all the courses that teachers have published successfully. 2 If the students have selected all courses in the platform and some courses overlap in the class time, the platform will give the students corresponding prompts. 3 If the average daily learning time of the course selected by students exceeds 8 hours, the program on the platform will prompt the students to time out.			

Table 5 Selection of courses (continued)

Applicable users		*Student*
Function name		Choose a course
Function description	4	If the same student chooses the same course uploaded by different teachers in the online distance music teaching platform, the platform will give the corresponding prompt to the students.
	5	Each student can choose up to 10 courses in the online distance music teaching platform.
	6	Students can also choose other courses to study after completing the course, but students cannot have more than 10 courses in the unfinished state in the platform.
Test result		Adopt

3.2.3 Management module

Platform settings:

Table 6 Platform settings

Applicable users		*Administrators*			
Input item description	Name	Length	Type	Constraint	
	/	/	/	/	
Function name		Platform settings			
Function description	1	Adjust the parameters of online distance music teaching platform.			
	2	Integrate other online distance music teaching platform resources.			
	3	Provide function interface.			
Test result		Adopt			

Platform layout:

Table 7 Platform layout

Applicable users		*Administrators*			
Input item description	Name	Length	Type	Constraint	
	/	/	/	/	
Function name		Platform layout			
Function description	1	According to the needs of users, the interface layout of online distance music teaching platform is set and adjusted.			
	2	It can accept the user's personalised customisation.			
Test result		Adopt			

Through the functional modules test of online distance music teaching platform based on Internet Plus, the function of online distance music teaching platform based on Internet Plus has reached the goal of this paper, and the test results are also in line with the expected requirements. Based on the test of platform functional modules, non functional

testing of online music teaching platform based on Internet Plus is conducted, to ensure that online distance music teaching platform based on Internet Plus meets the requirements of the application.

The overall experimental scheme is set as follows: taking response time and security as experimental comparison indexes, the proposed method is compared with the methods in Zheng and Ge (2017) and Liu and Guo (2017).

1 Response time: response time refers to the response time of different platforms to user operations. The shorter the response time is, the better the performance of the platform is.

2 Security: security refers to the probability of malicious intrusion on different platforms. The lower the intrusion rate is, the higher the security of the platform is. The calculation formula is as follows:

$$y_n = \frac{u_n}{r} \times 100\% \tag{8}$$

where r is the total number of intrusions and u_n is the number of successful defences.

3.3 Comparison of response time

The comparison results of response time of the three platforms are shown in Table 8.

Table 8 Comparison results of response time

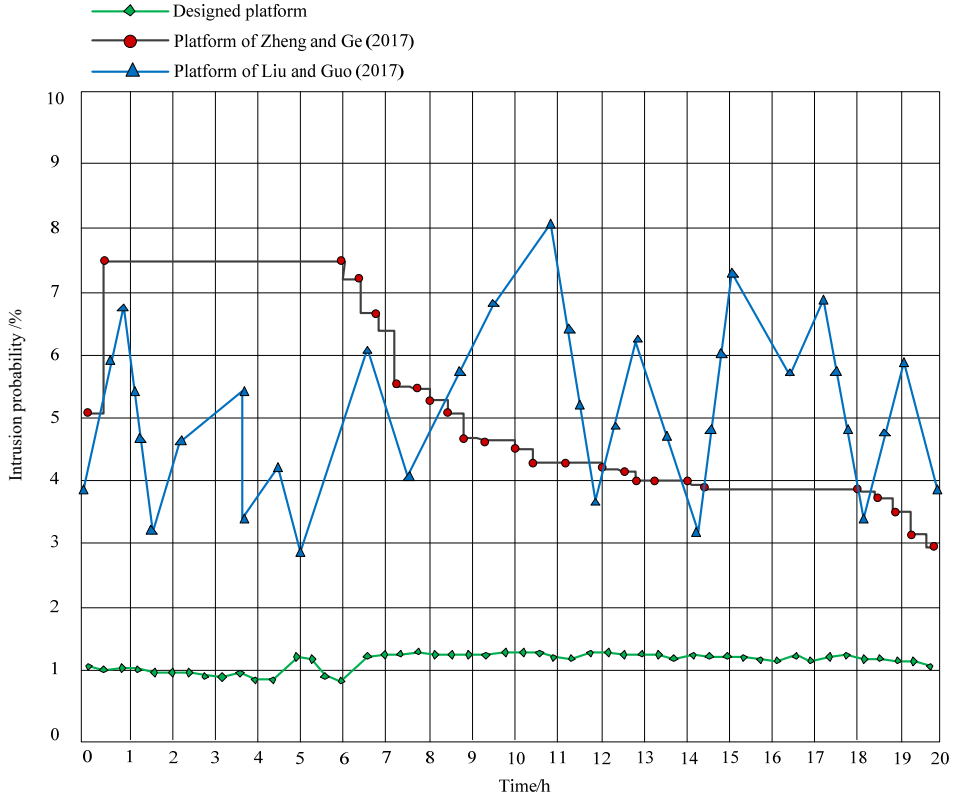
Number of concurrent users	*Response time/ms*		
	Designed platform	*Platform in Zheng and Ge (2017)*	*Platform in Liu and Guo (2017)*
20	290	1,235	1,485
40	293	1,463	1,496
60	295	1,574	1,562
80	297	1,658	1,645
100	299	1686	1,748
120	308	1,725	1,756
140	315	1,784	1,825
160	319	1,806	1,859
180	326	1,895	1,974
200	330	1,921	1,951

From the comparative experimental results in Table 8, it can be seen that the response time of the designed platform is far lower than that of the two reference comparison methods. When the number of concurrent users reaches 200, the response time of the designed platform is 330 ms, which is less than 340 ms, which indicates that the designed platform has low response application. When the number of concurrent users is 200, the response time of Zheng and Ge (2017) and Liu and Guo (2017) is 1,921 ms and 1,951 ms respectively, which are higher than those of the designed platform.

3.4 Security test

The intrusion probability results of the three platforms are shown in Figure 4.

Figure 4 Security comparison results (see online version for colours)



From the security comparison results in Figure 4, it can be seen that the intrusion rate of the designed platform is lower than that of the two traditional platforms, and the maximum intrusion rate of the designed platform is less than 2%. However, the highest intrusion rate of the platforms in Zheng and Ge (2017) and Liu and Guo (2017) reaches 7.5% and 8.1%, respectively. Therefore, it is fully proved that the designed system has high security.

4 Conclusions

In order to improve the quality of music online teaching platform, the online distance music teaching platform based on Internet Plus is put forward. The following conclusions are drawn from two aspects of theory and experiment: the platform has low application time and higher security when it carries out long-distance music online teaching. Specifically, compared with the platform based on internet mobile terminal, the response time is greatly shortened, and the highest response time is 330 ms; compared with the

platform based on electronic 3D virtual reality, the security is significantly improved, and the maximum intrusion rate is 1.3%. Therefore, it fully explains that the teaching platform based on Internet Plus can better meet the needs of online music teaching. In the future research, we should strengthen the research of online distance music teaching mode to stimulate students' interest in learning.

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