Application of Cloud-Based Audio Real-Time System in Music Teaching

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Research Article

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Abstract

The rapid development of network science and technology has promoted the popularity of streaming media technology, which makes the audio image real-time system get a rapid development. For example, it plays a great role in video monitoring and conference, and also provides a lot of support for remote assistance and other technologies, in order to realize the synchronization of teaching in music and other directions when audio can be carried out in many different scenes. At the same time, we combined with some practical projects, in this paper; we carried out the research on the implementation of cloud system for music teaching. In this process, we use asp.net platform to develop the corresponding software functions. In the process of development, the user interface and business logic analysis are designed in a systematic way. After we have initially completed the design functions of the system, we will carry out the trial run part, and then try to run again. After that, we will carry out various tests to ensure that it has perfect functions and complete codes. All the ten deployments have been sorted out and improved by the corresponding system, so as to ensure that the system platform can be used normally and give users corresponding experience. This system uses a new B / S mode, MVC mode, and SQL sever2008 as the database. Then we process the data according to the application situation and demand information of cloud system education, and find that these data give the user's needs, including the collection of various functional blocks into specific system modules.

1. Introduction

The development of information media not only promotes the progress of the entertainment industry, but also promotes the promotion of education. Under the current network environment, modern teaching management systems have been used in many large, middle and elementary schools, making the traditional education model have been greatly impacted and changed [1]. Therefore, we also need to make corresponding improvements in this aspect of music teaching to adapt to the current trend of networked teaching, and the development of efficient music education puts forward higher requirements [2]. Therefore, if we want to better carry out the teaching management of music-related education, we can improve the quality of music teaching in the country. Therefore, based on these conditions, we must carry out corresponding reforms and developments and perfect the system for music teaching management [3]. It is very important to cultivate compound talents at the current stage. On the basis of these educational management networked information platforms, the conditions for cultivating compound talents can be more complete and enriched. Among the higher education institutions in our country, the music education management mode of most schools is still in the stage of exploration and gradual practice, and there are many problems [4]. Therefore, we still need to continue to conduct in-depth related research. These systems can be fully improved, so that the advantages that management information can show on the network platform can be fully developed [5]. Therefore, music education in colleges and universities must be placed on a very important position, and the corresponding teaching management research also needs a lot of effort to continue to carry out.
Therefore, based on the statistical data of many consulting companies at home and abroad, we can study that in the long period of time in the past, my country the demand for content in music teaching has greatly increased, and this increasing trend will continue for a long time in the next few years [6]. Therefore, in this article, we have implemented a transmission system by modifying the system and applying the theory to the simulation method based on the various issues that have been raised above. This kind of transmission system can be related to real-time audio transmission [7]. It can also send the audio transmission algorithm and audio synchronously. This data transmission method can modify the routing node so that when the user sends an audio transmission request. This kind of data request is sent to the next routing node, and when the content is returned to the previous routing node, the next audio and data request can be completed very quickly. In this two-way simultaneous processing method, the content can be quickly transferred [8]. To the user's device. At the same time, the transmission speed is increased, and the user's access time is greatly reduced. Compared with other conventional methods, this kind of data transmission abacus is more transparent for network users [9]. People's applicability to this kind of data access has greatly improved our use of this kind of transmission system after modifying the NFD protocol, and by adding a transmission strategy, the algorithm is placed in the routing node of the network, and the file parameter is realized [10].

2. Related Work

Under the current development of the online education system, the traditional music education model has fallen behind the times. The literature proposes that a new type of online music education is booming, and at the same time, with the help of streaming media technology, we can gradually introduce music education on the right track. In this way, the modern development of music education can be promoted [11]. At the same time, it is believed in the literature that the success of streaming media technology has made a breakthrough in traditional online education. In the process of teaching, we have applied the diversified and interactive modes embodied in modern classrooms into this system. In the process of teaching, the teacher can use the various hardware equipment provided in the school in the classroom. For example, he uses self-made courseware to play these audio videos and teaching content [12]. Compared with the traditional models in the past, the content of the courseware is also can be further improved and developed. The literature proposes that the conversion of text information to audio, etc., makes it unnecessary for teachers to write a large number of blackboards in the classroom and consumes unnecessary time [13–14]. The pilot and practice of online education and according to the data show that more than 1 million students have registered and studied on the online education platform. This fully shows that this system model of online music education has been initially constructed [15] Many universities are beginning to expand further. For example, the use of network technology in the classroom, etc., at the same time, more and more subjects can be taught online. In this article, the explorers let us, in order to solve these problems, need to refer to some open source algorithms on the Internet to understand the conceptual design of this system [16]. Part of the core algorithm of the system is rewritten and re-architected to achieve a certain balance between transmission speed and sound quality on a corresponding basis. The literature explains various schemes of simulating network
topology and provides some channel network nodes for data processing and collection. This is a network starting point based on Linux code design, forming NFD related conversion plates, and on this basis build a corresponding audio transmission system, these network nodes communicate with each other to form a corresponding network conversion section, name this network conversion section, and build a transmission product-related system on the basis of this section, so that such network nodes constitute a realistic NDN network [17].

3. Audio Real-time Cloud System Technology

3.1. Real-time audio transmission

The collection and development of the Internet era has triggered a brand-new revolution in the field of information transmission, making the distance between people from the previous letter to the current one without leaving home, and real-time real-time communication between two terminals is possible. This provides a great test for us to efficiently and correctly transmit audio, video and other information resources on the Internet.

Audio technology itself is a small branch of multimedia technology in the Internet. The source of various related scientific research institutes lies in the increasing demand for video conferencing technology.

3.2. Basic algorithm model

Figure 1 specifically shows the details of the network topology.

First of all, we believe that network transmission has reached a stable level of convergence after a period of time, and the network itself has the following limitations:

\[
v_c \leq \frac{1}{t_r}
\]

1

\[
v_{mx} = v_{my}
\]

2

\[
c_{mt} \leq 2 \times \frac{d_{mip}}{t_T}
\]

3

This is basically a simple linear design problem. Because there is no two-way constraint, the equal sign itself can be maintained, and the extreme solution is the optimal solution.

\[
v_c \leq \frac{1}{t_T}
\]

4
And so

\[ v_{mt} = v_{mi+1} \]

Can get

\[ c_{Mmax} = 2 * d_{Mmaxp} / t_T \]

At last

\[ C_{M_{cx-1}} = c_{M_{xx}} * d_{M_{max-1}M_{max}} / d_{M_{max}T} \]

\[ C_{M1} = c_{mi+1} * d_{mi+1} / d_{mi+1mi+2} \]

We will explain its importance based on the actual network system.

In the network, the reproduction speed is not higher than the content generation, and the average transmission speed of the network has nothing to do with the delay of the connection, because of the continuous requirement to be able to receive continuous content. In fact, what is related to connection delay is that the ability to obtain the maximum content from the content originator at a given time and its size are related to connection and content delays, and productivity.

3.3. Audio data acquisition and processing

After transmitting the audio signal from the microphone to the sound card, the sound card will not effectively digitize the sound signal. These tasks must be programmed to fill the sound card. This article briefly introduces the OpenAL solution, which has open source and cross-platform functions. It defines and implements the volume according to the resolution used for digital audio editing. Its length is calculated according to the following formula:

\[ \text{Length} = \text{samplesPerFrame} \times \text{channels} \times \text{bits} / 8 \]

\[ \text{timePerVideoFrame} = 1000 / \text{fps} \]
The theoretical period PerAudioFrame, which is the time required to collect the sound frame, can be obtained according to the formula.

\[
\text{timePerVideoFrame} = \frac{1000 \times \text{samplesPerFrame}}{\text{sample_rate}}
\]

The video example is a theoretical value calculated based on the frame rate, and the actual time used for a specific capture is temp. The calculation method of the difference between the waiting time and u time is as follows.

\[
\text{wait}_{\text{time}} = \begin{cases} 
0, & \text{temp} \geq \text{interval} \\
|\text{temp} - \text{interval}|, & \text{temp} < \text{interval}
\end{cases}
\]

Overlap of digital audio and PCM data obtained by digitizing an analog audio signal. It is also possible to combine multi-channel data for quantizing audio to realize multi-channel audio mixing that can be realized by software. Many points must be considered when transmitting digital audio: simple encoded data, the scanning speed must be the same, and the quantitative accuracy must be the same.

If there are two sets of uncomplicated audio data A and B, they have the same scan S, the same accuracy N, and the scan data corresponding to a specific time t are \( A_t \) and \( B_t \), then the mixed result \( M_t \) can be obtained based on the following formula

\[
M_t = \begin{cases} 
A_t + B_t, & -2^{N-1} < a_t + b_t < 2^{n-1} - 1 \\
2^{n-1} - 1, & a_t + b_t \geq 2^{n-1} - 1 \\
-2^{n-2}, & a_t + b_t \leq -2^{n-1}
\end{cases}
\]

The prototype of the encoding function is encodng16PCM2AAC, the pem data is the PCM data to be encoded, the data size is the length of the pcm data, and the data packet is the target encoded data packet.

\[
\text{data}_{\text{size}} = \text{sampleNum}
\]

After initializing the file and adding the video and audio stream information, you have received the information required for storage and the required stream information, which is stored in fmtCtx. Next, evaluate whether E/A is turned on after avoOpened.

\[
\text{newPts} = \text{pts/codecCtxTimeBase8streamTimeBase}
\]
Because the members `videoFrameNum` and `audioFrameNum` in each class record the number of video and audio images written to the file, these two values can be retrieved through the functions `WrittenVideoFrameNum` and `getWrittenAudioFrameNum`. Write video duration, video duration `videoVariation` and audio duration, as well as video frame rate `fps`, `audioFrameNum` and audio scan rate `sample_rate`, as shown in the following formula.

\[
\text{videoDuration} = 1000 \times \frac{\text{videoFrameNum}}{\text{fps}}
\]

\[
\text{audioDuration} = 1000 \times \frac{\text{audioFrameNum} \times \text{SamplesPF}}{\text{sample_rate}}
\]

\[
\nabla^2 n = \frac{1}{c^2} \frac{a^2 n}{at^2}
\]

The solution of (18) can be represented by a zero-order cylindrical Bessel function:

\[
n(t, r) = A J(kr) e^{iw}
\]

Continue processing to get the frequency equation:

\[
f_n = \frac{un}{2\pi a} \sqrt{\frac{t}{\sigma}}
\]

The signal processing mainly includes analyzing the received frequency, and then evaluating whether the dose is qualified according to the set parameters. It is assumed that the analog tone signal received from the microphone is frequency information that can be obtained by Fourier transform.

\[
X(f) = \int_{-\infty}^{+\infty} x(t) e^{-j2\pi ft} dt
\]

However, the audio signal received by the microphone not only contains the sound of tapping the lid, but also contains background noise from the surrounding environment. When the two volume levels are relatively close, the analysis results are more affected. And noise reduction processing is necessary.
\[ X[k] = \sum_{n=0}^{n-1} x[n] e^{-j\frac{2\pi}{n}km} \]

This is the Fourier transform, and \( N \) represents the frame length of the data.

\[ f = \frac{k}{n} f \]

The number of doses \( v \) minutes that can be measured is calculated according to formula (24).

\[ v = 60 \cdot \frac{f}{n} \]

24

3.4. Algorithm simulation analysis

The frequency domain transform number is the most common compression algorithm in current sound compression algorithms. The frequency domain transform number can distinguish the high and low frequency sensitivity of the human ear sound signal completely through the psychoacoustic model of the human ear, and then extract and compress the best spectrum package.

The different response times of A and B are represented by the line graph in the table. Specifically as shown in 2:

4. Music Teaching Cloud System Based On Audio Real-time System

4.1. System requirement analysis

First of all, the design of the front desk of the system is proposed. The main core content of this design is the realization of human-computer interaction. Among the related requirements of human-computer interaction of this system, corresponding function buttons need to be provided in the following modules. The front desk showed them to the interface, while the user using this episode is as follows.

(1) Virtual classroom

This is a brand-new network teaching concept extended from the system that appears in this topic, which is to provide students with the corresponding resources through the actual classroom of the existing information technology conditions. In the traditional teaching mode, the corresponding role positioning is classroom. So we call this concept a virtual classroom. Through the application of this model, teachers can better carry out the work of student management.
(2) Performance appreciation

The interactive function of performance appreciation is one of the basic functional conditions of this collaboration. Among the current various music education website systems, the collaboration itself will bring some traditional simple classical teaching repertoire appreciation. This function can be considered as a public function. One of them can be used for the initial understanding of the system and teaching work for all users of the system, including all kinds of students, tourists and registered teachers. The repertoires played can be screened and uploaded to the public open platform by teachers provided by the platform, and teachers can also arrange corresponding exercises for students based on these repertoires.

(3) Tutorial live broadcast

This function is based on the current situation of online education and provided in teaching activities and live broadcast, so that teachers and students can conduct real-time teaching through the network within the time period specified in the guest schedule. This requires the teacher to report to the system first. The administrator of the platform applies for access to the classroom. After the administrator coordinates the information arrangements of all parties, inform the students of the corresponding course schedule and class time. After that, teachers and students can learn in the live classroom through the implementation of pictures and audio transmission.

(4) Examination class

The function is only set up for those candidates who have music grading needs. Through the guidance of professional teachers to help them pass the corresponding examinations, in this section, students have the right to choose their own courses.

(5) Personal information management.

This platform is the place where relevant user personal information can be modified and corrected. Including the input or modification of a series of information such as the user name and password of the teacher and the student, as well as the personal name and ID number.

4.2. Principles of system design

In our systematic design, we need to follow the following principles to carry out the corresponding design: In the process of system design, the framework we use is the BS layer architecture, because we need to use the environment according to the users. Different needs are contacted with reality. Therefore, the three-tier basic architecture model is adopted, which can improve the compatibility of using the system in different environments. Users only need to use browsers such as IE and 360 to access the system.

The system topology of the online music education system is shown in Fig. 3.

According to the system topology diagram in Fig. 3, it can be seen that during webcasting, the teacher may use the camera to take a video and then upload it to the live broadcast platform simultaneously, and
the students can watch it instantly through the live broadcast platform.

4.3. Functional analysis and module design

The function of each component of the online music system is shown in Fig. 4.

(1) Virtual classroom design

The virtual classroom occupies a confirmed and important position on the online music system education platform, and can be considered as the basic functional unit of this system. This is the main place for students to conduct teaching activities in the classroom. Position in the system is crucial. Therefore, we must properly design the virtual classroom function. For students, the functional atmosphere of the virtual teacher exists and applies to join the classroom and view the relevant information of the classroom frame and so on. For teachers, the functions that need to be used include creating classrooms and configuring the various functions of the classroom, and so on. Below we will describe several of these functions.

The first is to create and train teachers who need to fill in relevant course information when implementing this function. For example, the subject content of the class and the time of the class. Then give the administrator review. At the same time, teachers should strictly design courses according to the suggestions put forward by the administrator, and also take into account the students' learning situation and personal time, etc. After the teacher completes all kinds of relevant information and the teacher's application is approved, a virtual classroom corresponding to the course can be formally created.

4.4. Database Design

The system database can be fully adapted to the various functions of the system, and a reasonable design of the database can make the activities you have thought of more quickly and also very convenient.

(1) Student information form

The basic situation of the student user table. The specific content is shown in Table 1 below.
(2) Teacher information form

The basic situation of the teacher user table is shown in Table 2.

Table 2  
Teacher User Table

<table>
<thead>
<tr>
<th>Field</th>
<th>Types</th>
<th>Primary</th>
<th>Foreign</th>
<th>Can it be empty</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>TeacherID</td>
<td>int</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>Teacher number</td>
</tr>
<tr>
<td>Name</td>
<td>varchar</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Name</td>
</tr>
<tr>
<td>Password</td>
<td>varchar</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Password</td>
</tr>
<tr>
<td>Age</td>
<td>varchar</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Date of birth</td>
</tr>
<tr>
<td>Sex</td>
<td>varchar</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Gender</td>
</tr>
<tr>
<td>Email</td>
<td>int</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Mailbox</td>
</tr>
<tr>
<td>Address</td>
<td>varchar</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>Home address</td>
</tr>
<tr>
<td>Telephone</td>
<td>varchar</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>Telephone number</td>
</tr>
</tbody>
</table>

(3) Administrator information form

The basic situation table of the system administrator is shown in Table 3.
Table 3
System administrator table

<table>
<thead>
<tr>
<th>Field</th>
<th>Types</th>
<th>Primary</th>
<th>Foreign</th>
<th>Can it be empty</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Admin ID</td>
<td>int</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>Manager number</td>
</tr>
<tr>
<td>AdmTypc</td>
<td>varchar</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>account number</td>
</tr>
<tr>
<td>Password</td>
<td>int</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>Password</td>
</tr>
<tr>
<td>Namc</td>
<td>data</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Name</td>
</tr>
<tr>
<td>LastTimc</td>
<td>date</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Login date</td>
</tr>
<tr>
<td>Last IP</td>
<td>date</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Login address</td>
</tr>
<tr>
<td>comments</td>
<td>varchar</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>Other</td>
</tr>
</tbody>
</table>

(4) Virtual classroom information form

The basic situation of the virtual classroom user table is shown in Table 4.

Table 4
Virtual classroom table

<table>
<thead>
<tr>
<th>Field</th>
<th>Types</th>
<th>Primary</th>
<th>Foreign</th>
<th>Can it be empty</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ClassID</td>
<td>int</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>Classroom number</td>
</tr>
<tr>
<td>ClassType</td>
<td>varchar</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Classroom type</td>
</tr>
<tr>
<td>Creator</td>
<td>int</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>Creator name</td>
</tr>
<tr>
<td>CreTimc</td>
<td>date</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Creation date</td>
</tr>
<tr>
<td>cCourscNum</td>
<td>date</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Number of courses</td>
</tr>
<tr>
<td>StudentNum</td>
<td>date</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Number of trainees</td>
</tr>
<tr>
<td>comments</td>
<td>varchar</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>Other</td>
</tr>
</tbody>
</table>

5. Conclusion

The main research work of this paper includes the following: First, this paper proposes a real-time follow-up program for the original multimedia software live broadcast. At the same time, we use a series of other related software to carry out scenarios from multiple sources. Synchronous records, related storage and loading into different systems, as well as real-time exchange on the network and release on the platform, etc. In this way, we have realized the network sharing of these videos, and we have involved some RTSP-based on this system. In the design process of the system, this paper analyzes the actual needs in the process of music teaching in detail, and practically combines the teaching and learning situation of
teachers and students to design the functional framework of the system. At the same time, corresponding analysis and explanations are made for these designs, and each function is systematically improved.

**Declarations**

**Conflict of interest**

The authors declare that they have no conflict of interests.

**Ethical approval**

This article does not contain any studies with human participants performed by any of the authors.

**Data Availability**

Data will be made available on request.

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Figures
Figure 1

Network topology
Figure 2

Comparison performance analysis of flooding/active caching strategies

Figure 3

System topology
Figure 4

function of each component