

# Application of Virtual Reality in Music Teaching System

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**Abstract**—In order to improve vitality and efficiency of teaching in music, with the multi-sensing, immersion and interactivity feature in the virtual reality (VR) technology, the VR system can solve the low cross mutual inductance and low efficiency in traditional music teaching. An online error identification algorithm was proposed in the paper. The teaching performance was evaluated with dimensions and confirmatory factor analysis. The results indicate the enthusiasm of students' autonomous learning and learning efficiency has been greatly improved with teaching system.

**Index Terms**—virtual reality, music teaching system, storage strategy, data mining

## I. INTRODUCTION

With the development of society informatization, the computer has been widely applied in the daily teaching and has become the indispensable modern teaching infrastructure and technical support environment. The teaching management system can significantly improve the students and the teachers in the information sharing and the quality of teaching. For a music teacher, the music teaching management system includes the teachers' personal information, the teaching information query, the teaching file management and the teachers' evaluation of the students and the course[1-2].

In the 21st century, the whole of human society is developing human understanding for the way of perception at an alarming rate changes with the development of technology and culture. People are trying to rely on computer networks and the existence of virtual reality technology to expand into more of the space environment and enjoy the colorful visual feast of the virtual world. Virtual reality technology is an immersive interactive technology which is based on computer technology and data processing technology. It creates a real-time interactive three-dimensional space. From virtual reality users can operate and apperceive all of the various objects in the virtual world and make access to the space and logical information implied among the virtual environment.

The virtual reality is the computer simulation three dimensional environments, is one kind may found and experience the hypothesized world the computer system. It through human's vision, sense of hearing, touching, tasting and smelling function in the user, causes the human produces experiences personally ground view simulation. Because of the hypothesized technology produces hypothesized artistic atmosphere, space and environment by using the computer, not only may the reality but also the unreality be object, direct-viewing. This can differ the reality and the unreality, and has broken down the strict boundary between both. It will be the real-time communication, have the sound-surround ambiance. The applica-

tion of Virtual reality, which causes the music teaching, the demonstration, the creating and the sharing and so on to be more scientific, effective, appropriate. It also conforms to the characteristic and the request of the current information age. Its goal is to use formidable computing power and graph exaggeration ability of computer, and make hypothesized world which seems real sufficiently.

Due to the poor interaction of traditional music teaching method, the efficiency of the usage of music teaching resources is low. In order to solve the problem, visual reality thinking should be used to reform the traditional music teaching method.

Having been developed for more than 20 years, the technique of virtual reality (VR) has become one of the most important and inventive 21th century technologies, paralleling with internet and multi-media. VR is a type of synthetic integration technique, which integrates computer graphics, computer human interaction, sensor technique, artificial intelligence, robotique, etc. and features with multi-sensing, immersion, interactivity and imaginary, etc. Therefore, we can use the virtual reality technology to solve the problem of low cross mutual inductance and low efficiency in tradition music teaching.

## II. OVERVIEW

At present, in respect to the manner of education research in China is still in its infancy, because want to explore the way of education, first of all, to be well informed about the multiple education methods, to further explore the correct conclusion. Ministry of education on the education facing the 21st century revitalization action plan [3-5], the article has made clear that are widely used in the modern information technology in education leads to profound changes in the education system. In terms of vocal music education field, the category of longitudinal fine development and integration with other subjects is an important trend of the development of the contemporary vocal music, increasing its total knowledge information geometric type [6-7]. Reflected in the vocal music discipline, mainly to enrich the song theory, a new mechanism and singing techniques and style of the deepening of the study, with the integration of related subjects and infiltration is increasingly strengthened. This shows that it is very necessary to apply virtual reality technology to music teaching system. This is also the need of the development of the times [8].

With the development of social productive forces and science and technology, VR technology is growing demand in all kinds of fields. The research of virtual reality and VR software is of vital importance day by day. Virtual Reality is a new research paradigm in psychology research area; it has some characteristics such as multi-perception, immersive and interaction. In recent years, with the devel-

opment of network and multimedia technology, the comprehensive technology, virtual reality (VR), is being increasingly applied to all walks of life, providing more multi-dimensional information display. With its rapid development, more applications in many fields have made a breakthrough progress, such as city planning, industrial simulation, virtual studio, medicine, education, aerospace, entertainment, art etc. [9-10]. Research on virtual reality technology in the field of education has become more and more mature, especially in language learning, learning environment construction and simulation campus' application and implementation. Virtual reality solves the problem that perception and action separating, leads the perception and action study more natural, improves the study ecological validity, and holds great promise for the study of perception- action. In decades, researches about the relationship between perception and action in baseball, handball and tennis found that, athletes can make exact interceptive actions in virtual environment [11].

Figure 1 shows an instrument playing system based on the visual reality technology. And Figure 2 shows the a student learning by the system.

### III. METHOD AND ALGORITHM

The Flash animation, 3D Max vocalists teaching research, teaching achievement belongs to "the Project of Vocal Music Construction" characteristic teaching methods and means of teaching. The results of teaching for free and open online sound related audio and video teaching resources link has played a strong supporting role to the visual reality platform, realizes the high quality teaching resources sharing. Completely changed in the past of vocal music teachers' subjective understanding on singing organs inaccurate interpretation, solved the teachers for singing organs use description, solved the students understand the deviation caused by the misunderstanding can sing muscle operation out of control; For interdisciplinary teaching and research on the thinking and ideas, methods and means of updating and breakthrough innovation significance to effective development, promote the quality education resources sharing at the same time, will make the students get the best education, so as to comprehensively improve the quality of vocal music teaching.

A less self-disciplined developer, who committed software plagiarism, may elude punishment by seriously disguising the original open source projects.

The basic model for online error identification as follows:

$$TSP(t) = \begin{cases} TSP_1 & 0 \leq t \leq \Delta t \\ TSP_2 & \Delta t \leq t \leq 2\Delta t \\ \mathbf{L} & \\ TSP_n & (n-1)\Delta t \leq t \leq n\Delta t \end{cases} \quad (1)$$

$$\min d(T) = \sum_{k=1}^n \sum_{i=1}^N \sum_{j=1}^N c_{i,j}(kg\Delta t) \quad (2)$$

$$s.t \quad \Delta t = \frac{T}{n}, \frac{\Delta c_{i,j}}{\Delta t} = 0 \quad (3)$$

We may get the calculating method for the main index in the following equation (4)-(5):



Figure 1. An instrument playing system based on the visual reality technology



Figure 2. A student learning by the system.

$$M_{ij} = \exp\left(-\frac{\|x_i - x_j\|^2}{\sigma^2}\right) \quad (4)$$

$$L = \begin{bmatrix} L_1 & & \\ & \mathbf{0} & \\ & & L_k \end{bmatrix} \quad (5)$$

Their matching eigenvectors matrix is shown in the following equation (6):

$$H = [h_1, h_2, \dots, h_k] = A^{1/2}E \quad (6)$$

So, we can get:

$$U_{ij} = \frac{H_{ij}}{\sqrt{\sum_{t=1}^k H_{it}^2}}, i=1, \dots, n, j=1, \dots, k \quad (7)$$

$$P = I - A^{-1/2}MA^{-1/2} \quad (8)$$

According to the equation (6), the calculating formula can be obtained in equation (7)-(10).

$$g(x, \omega) = \frac{1}{(2\pi)^3} \int g(k, \omega) \exp(-ik_g x) dk \quad (9)$$

$$g(k, \omega) = \begin{bmatrix} G_{ik}(k, \omega) & \gamma_i(k, \omega) \\ \gamma_k^T(k, \omega) & g(k, \omega) \end{bmatrix} \quad (10)$$

$$G_{ik} = (\Lambda_{ik} + \frac{1}{\lambda} h_i h_k^T)^{-1}, \quad g = -(\lambda + h_i^T \Lambda_{ij}^{-1} h_j)^{-1},$$

$$\gamma_i = \frac{1}{\lambda} h_k^T G_{ki}, \quad (11)$$

$$\Lambda_{ik}(k, \omega) = k_j C_{ijkl}^0 k_k - \rho_0 \omega^2 \delta_{il}, \quad h_i(k) = e_{kil}^0 k_k k_l$$

$$, \quad h_l^T = e_{ikl}^{0T} k_i k_k,$$

$$\lambda(k) = \eta_{ik}^0 k_i k_k \quad (12)$$

$$\frac{1}{2\pi} \int_{-\infty}^{\infty} e^{-ik_3 x_3'} dx_3' = \delta(k_3) \quad (13)$$

$$s(X \rightarrow Y) = \frac{\sigma(X \cup Y)}{N} \quad (14)$$

$$c(X \rightarrow Y) = \frac{\sigma(X \cup Y)}{\sigma(X)} \quad (15)$$

The formula generates labels for each file block.

$$for(j = 0; j \leq n - 1; j + +); \quad (16)$$

$$\{W_j = r * (j + 1); T_i$$

$$= [h(W_j) * m_j]^c \bmod N\}; \quad (17)$$

$$Output(T_0, T_2, \dots, T_{n-1}); \quad (18)$$

And local fractional integral of  $f(x)$  defined by Eq.9.

$${}_a I_b^{(\alpha)} f(t) = \frac{1}{\Gamma(1 + \alpha)} \int_a^b f(t) (dt)^\alpha$$

$$= \frac{1}{\Gamma(1 + \alpha)} \lim_{\Delta t \rightarrow 0} \sum_{j=0}^{j=N-1} f(t_j) (\Delta t_j)^\alpha \quad (19)$$

Its local fractional Hilbert transform, denoted by  $f_x^{H,\alpha}(x)$  is defined by

$$H_\alpha \{f(t)\} = \hat{f}_H^\alpha(x)$$

$$= \frac{1}{\Gamma(1 + \alpha)} \int_R \frac{f(t)}{(t - x)^\alpha} (dt)^\alpha \quad (20)$$

Where  $x$  is real and the integral is treated as a Cauchy principal value, that is,

$$\frac{1}{\Gamma(1 + \alpha)} \int_R \frac{f(t)}{(t - x)^\alpha} (dt)^\alpha$$

$$= \lim_{\epsilon \rightarrow 0} \left[ \frac{1}{\Gamma(1 + \alpha)} \int_{-\infty}^{x-\epsilon} \frac{f(t)}{(t - x)^\alpha} (dt)^\alpha + \right. \quad (21)$$

$$\left. \frac{1}{\Gamma(1 + \alpha)} \int_{x+\epsilon}^{\infty} \frac{f(t)}{(t - x)^\alpha} (dt)^\alpha \right]$$

#### IV. EXPERIMENT RESULT

The innovation of teaching has been applied in the vocal music classroom teaching implementation, college of art media gathered the vocal music quality education resources, efforts to improve the quality of teaching, make students get the best education. The music teaching system mainly focus on the larger the range of internal existing classic teaching theory on the basis of using the modern high-tech multi-media teaching of vocal music teaching sharing activities, combined with the advantage of college, break the traditional "dictate syncretism" abstract vocal music teaching mode, the singing teaching in the process of breathing, resonance, articulation, take the lead in using the simulation and visually rich, and as far as possible, improve the traditional vocal music teaching in the abstract, is not easy to master will sing. A new teaching way in the current vocal music teaching and research is an innovation at home and abroad. The vocal music construction will meet the purpose of the cultivation of high-quality talents.

The table 1 shows the dimension measurement for evaluating the performance of music teaching system. After the experiment, measurement variable values of skewness and kurtosis is shown in the table 2. Table 3 shows the behavior of confirmatory factor analysis.

TABLE I.  
THE DIMENSION MEASUREMENT

Dimension	Measurement	Dimension	Measurement
Opportunistic Behavior (OB)	music systems against commitment (X1)	Enterprise quality management (EQM)	high-level participation (Y1)
	Music system against informal agreement for maximum benefit (X2)		The quality of training (Y2)
	Music system drill a loophole in the contract to obtain interest (X3)		Product design (Y3)
	Music system use accident forced our concessions (X4)		Process management (Y4)
Sharing behavior (SB)	Music systems shared their production plan (X5)		Quality data (Y5)
	Music systems share their production capacity (X6)		Benchmarking enterprise (Y6)
	Music systems share their production inventory (X7)		Customer relationships (Y7)
	We share production plan with music systems (X8)		Employee relations (Y8)
	We Shared production capacity with music systems (X9)	Music system quality management (SQM)	Music system management (Y9)
	We Shared production inventory with music systems (X10)		Music systems choose (Y10)
We Shared our music systems demand forecasting (X11)	Music system participation (Y11)		
Cooperative behavior (CB)		Music system delivery processing speed (X12)	
		music system's delivery processing quality (X13)	
	Music system of processing problem (X14)		
	Music systems' participation in product design level degree (X15)		

PAPER  
APPLICATION OF VIRTUAL REALITY IN MUSIC TEACHING SYSTEM

TABLE II.  
MEASUREMENT VARIABLE VALUES OF SKEWNESS AND KURTOSIS

Variable	degrees of skewness		degrees of kurtosis		Variable	degrees of skewness		degrees of kurtosis	
	Statistic standard	S.E	Statistic standard	S.E		Statistic standard	S.E	Statistic standard	S.E
X1	0.344	0.160	0.039	0.318	Y1	0.595	0.160	-0.224	0.318
X2	0.172	0.160	-0.926	0.318	Y2	0.400	0.160	-0.098	0.318
X3	0.219	0.160	-0.629	0.318	Y3	0.239	0.160	0.404	0.318
X4	-0.148	0.160	-1.318	0.318	Y4	0.326	0.160	1.039	0.318
X5	-0.100	0.160	0.222	0.318	Y5	0.256	0.160	-0.052	0.318
X6	0.316	0.160	0.105	0.318	Y6	0.051	0.160	0.192	0.318
X7	0.201	0.160	-0.213	0.318	Y7	-0.393	0.160	0.239	0.318
X8	-0.087	0.160	0.189	0.318	Y8	0.392	0.160	-0.005	0.318
X9	-0.033	0.160	-0.254	0.318	Y9	0.433	0.160	0.331	0.318
X10	-0.029	0.160	-0.175	0.318	Y10	0.478	0.160	0.062	0.318
X11	-0.083	0.160	-0.292	0.318	Y11	-0.143	0.160	0.775	0.318
X12	0.481	0.160	-0.453	0.318					
X13	0.471	0.160	-0.503	0.318					
X14	0.452	0.160	-0.073	0.318					
X15	-0.205	0.160	0.650	0.318					

TABLE III.  
BEHAVIOR OF CONFIRMATORY FACTOR ANALYSIS

Potential factors	observed variables	Load Reliability	coefficient	measurement error	T	P	Reliability Mean	Average Variance Extracted
Opportunistic Behavior (OB)	X1	0.713	0.508	0.492	-	-	0.878 0.878	0.644 0.644
	X2	0.755	0.570	0.430	4.407	***		
	X3	0.856	0.733	0.267	4.397	***		
	X4	0.875	0.766	0.234	4.410	***		
Sharing behavior (SB)	X5	0.771	0.594	0.406	-	-	0.906 0.906	0.580 0.580
	X6	0.731	0.535	0.465	11.592	***		
	X7	0.817	0.668	0.332	12.949	***		
	X8	0.782	0.611	0.389	11.927	***		
	X9	0.719	0.517	0.483	10.581	***		
	X10	0.793	0.629	0.371	11.736	***		
Cooperative behavior (CB)	X11	0.708	0.501	0.489	5.699	***	0.863 0.863	0.612 0.612
	X12	0.780	0.609	0.381	-	-		
	X13	0.766	0.587	0.413	11.199	***		
	X14	0.859	0.737	0.263	12.811	***		
	X15	0.711	0.506	0.484	2.537	0.011		

### V. DISCUSSION

Due to the poor interaction of traditional music teaching method, the efficiency of the usage of music teaching resources is low. In order to solve the problem, visual reality thinking is used to reform the traditional music teaching method.

Musical emotion is depended on tonality and certain term in the tonality, therefore to seek a kind of tonality determining algorithm with high efficiency becomes the key research content in this paper. In the experiment part, several typical dimension measurement is chosen for evaluating the performance of the music teaching system. Through analyzing the application of visual reality in music, a spiral model is used in the teaching system for the experiment, and then a kind of tonality determining algorithm is also proposed based on this model. From the experiment result, it is demonstrate that having been com-

pared with the existing Shape-Matching Algorithm and Probe Tone Profile Method, the algorithm proposed in this thesis determines musical tonality faster and satisfies the real-time demand of music visualization. This paper proposes the design scheme of music visualization system and describes the flow and process mechanism. From the above simulation result about the Measurement Variable values of Skewness and Kurtosis and behavior of confirmatory factor analysis which basically corresponds with music features such as rhythm, style, emotion and so on, and achieves good results.

Through the various nodes of the VR system and the setting of the Java script parameters, the music teaching model is able to dynamically perceive the emotion in the virtual environment and has achieved a variety of behavioral interactions. All of above it has arrived to implement the real music teaching behavior of a variety of realistic results.

## VI. CONCLUSION

Due to the poor interaction of traditional music teaching method, the efficiency of the usage of music teaching resources is low. In order to solve the problem, visual reality thinking should be used to reform the traditional music teaching method. In order to improve vitality and efficiency of teaching in music, the virtual reality technology is applied in the music teaching system. Professional music education course platform include professional basic course, specialized course, elective course and practice. Combined with the advantage of visual reality technology, break the traditional "dictate syncretism" abstract vocal music teaching mode, the singing teaching in the process of breathing, resonance, articulation, take the lead in using the simulation and visually rich, and as far as possible, improve the traditional vocal music teaching in the abstract, is not easy to master will sing.

The application of visual reality technology can solve the problem of the poor interaction of traditional music teaching method and the low efficiency of the usage of music teaching resources. A new teaching way in the current vocal music teaching and research is an innovation at home and abroad. The vocal music construction will meet the purpose of the cultivation of high-quality talents. Experiment result shows that by using this system, the enthusiasm of students' autonomous learning and learning efficiency has been greatly improved.

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