Hindawi
Scientific Programming
Volume 2022, Article ID 2097909, 12 pages
https://doi.org/10.1155/2022/2097909

Research Article

Application and Design of Drama Popular Science Education Using Augmented Reality

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Received 17 May 2022; Accepted 25 June 2022; Published 8 July 2022

Academic Editor: Mian Ahmad Jan

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In the 21st century, the research and development of all kinds of intelligent equipment have become an increasingly important part of people's daily life. Various emerging technologies are developed based on hardware equipment, such as augmented reality (AR) and virtual reality (VR), which fully utilize computer vision technology to accomplish various purposes. Nowadays, it is difficult to carry out opera popular science education in China. Because opera teaching is boring and some traditional opera knowledge is obscure and difficult to understand, it cannot arouse students' interest in learning. Therefore, this article uses VR technology to stimulate students' learning initiative and complete drama science popularization education with rich and colorful teaching means. It first briefly introduces the concept and characteristics of AR technology. After that, it establishes an AR-enabled drama application as an education model based on the statistical entity recognition algorithm and designs the drama popular science education app. Besides, it completes the drama animation design, character modeling design, drama scene design, logo pattern design, and animation design. Finally, from the two points of students' mastery of opera and learning opera knowledge, the actual use effect of this application is analyzed. The results show that this application can help students better learn opera: 42% of students can better master opera singing, 23% of students say they can master other types of opera, 18% of students can better learn and master opera movements and posture, and 10% and 7% of students can master a lot of opera knowledge.

1. Introduction

The advancement of media has been accelerated by the continuous upgrading and development of digital technologies. Information dissemination has transited from the original traditional media to the new media. A variety of induction devices and high-tech devices have been introduced. As a new emerging technology, augmented reality technology (AR) has become mature and widely used in various fields of science and technology, such as education, art, medicine, exhibition, and science popularization. Users use AR glasses to achieve multidirectional, multidimensional space-time scheduling, thus observing more virtual scenes and situations. Augmented reality (AR) is a technology that enables virtual things to be placed dynamically over real-time pictures [1]. This system delivers virtual elements and real-time pictures simultaneously and synchronously [2]. In augmented reality, virtual data are integrated into the user's physical surroundings, allowing the user to interact with the virtual material [3].

AR applications are divided into two categories based on the technology they employ: marker-based and marker-less. In marker-based AR applications, symbolic objects are received by a computer via a marker and a camera, resulting in the presentation of virtual content to the [4]. In marker-less apps, such as location-based AR applications, the user's real-world position is acquired using the GPS, and contextually appropriate virtual data are delivered to the user in regionally important areas. A present study on the usage of augmented reality (AR) apps in drama education shows that such programs have a favorable influence on education and learner attitudes [5]. As per a New Media Center research [6], augmented reality has several potential to transform educational environments, such as improving innovative approaches, teaching methodologies, and the organization and delivery of material, while motivation or skill attainment

is acknowledged as an essential cause for the creation of instructional aids [7]. Educators should evaluate how AR apps might be linked with instructional tactics or pedagogical approaches in drama education, just as they should with AR applications. According to research, using AR in drama education may allow educators to mix such apps with other pedagogical techniques such as contextual learning [8], inquiry-based learning, and game-based learning [9].

In light of the above, the traditional way of popular science education in opera still leads to a lack of students' interest in learning. This article uses the most advanced AR technology to design the educational application of popular science education in opera [10]. Most of the traditional forms of popular science education in opera take the way of broadcasting operas, movies, and TV dramas by showing them to the audience in a programmed way [11]. At the same time, the performance activities will be displayed to students by the personnel of the opera art team in combination with the situation and the way of popular science of opera art. The last is the Opera Art Gallery, which is based on the combination of two-dimensional paper media and three-dimensional screen media propaganda. This form of popular science education in opera is 2.5-dimensional [12]. This traditional form of youth, in which AR technology is utilized to disseminate virtual performance and understanding of opera, has received little support. Therefore, the goal of this technology is to record the complex interaction of opera cuts and so learn more about the popularity of opera science. This article attempts to create an opera popular scientific education application by merging traditional opera art and AR technology, which is suitable for better spreading China's opera art. This will help to promote and advertise the attraction of opera art. In addition, it integrates AR technology into traditional opera teaching by establishing the application of opera popular science education based on AR technology.

1.1. Innovations of This Article. The main innovations of this article are as follows:

(1) Integrating AR technology into the traditional opera popular science teaching, penetrating the traditional opera classroom teaching, and improving the activity of the opera classroom teaching [13].

(2) This article outlines the basic concepts and features of AR technology and introduces the entity recognition algorithm based on statistics, which is the theoretical basis for designing an APP for opera science education based on AR technology.

(3) Detailed description of the establishment of AR-based application process of popular science of opera, design of opera character shape, scene, logo pattern, and animation design, and set up a large Opera Dance database.

1.2. Organization of the Sections. Section 2 discusses the relevant work of national and internal scholars in the chosen field. Section 3 is based on the material chosen and the technique recommended. Section 4 describes the concept of an opera popular scientific teaching program based on augmented reality technology. Section 5 examines the outcomes of opera popular science education, and Section 6 brings this work to a close.

2. Related Work

These days, the world has entered a new era of technology, due to which foreign countries have remarkable advantages in this technology especially network technology. Diverse businesses have made various techniques, although AR enhancement technology is a large-scale commercial technology. Most technology firms started to investigate AR augmented reality technologies [5]. According to reports, AR technology can boost company attention by increasing business revenue [14]. Augmented reality is a new technology that enables various items, elements, and activities that cannot be accessible or implemented in real life to take place in the complexity of the actual world [15]. As a result, many national and international experts are focusing their studies on AR these days. The efforts of some AR researchers are detailed in this section.

The scholars of Ref. [16] studied site-based AR technology in the Science Museum, which is developed and applied on a computer so that visitors can watch AR effects on their computers, making AR technology significantly easier to use. Similarly, the early work of [17] constructs a school theater model for adolescents. The theater in the framework of this project is considered a special educational communication environment in which adolescents can experience the particularity of opera and learn more about the unknown, roles, and relationships. In this regard, the authors of Ref. [18] combine qualitative and quantitative approaches to clarify the social skills of opera teachers, use descriptive and meta-analysis methods to analyze the impact of drama on communication skills, and use social skills to evaluate the teaching social skills of opera teachers. In Ref. [19], the author investigates the current situation of local opera course development in Shaanxi, analyses the current problems of opera textbooks, and formulates a systematic and complete program for developing local opera courses from the aspects of training teachers, compiling teaching materials and teaching strategies. Similarly, the early work of Ref. [20] chose Zibo region local opera for research, based on music textbook course as the carrier, to analyze the problems encountered in the opera popular science education course, and to provide a basis for the use of five-tone opera in our school courses.

Based on the above, the author in Ref. [21] focuses on the analysis of traditional local opera teaching methods in the classroom and proposes to carry out opera science education in combination with campus cultural construction and opera education. Zhou Wei analyzed the problems that need to be dealt with urgently in the current opera class, used the mainstream media to build the national formula, and combined with the secondment training to strengthen the construction of the teaching staff, while, in Ref. [22], the author starts from a psychological perspective to analyze the

problems encountered in the teaching of traditional Chinese opera, arouse students learning initiative and interest, and deal with them by shortening the distance between students and the education of traditional Chinese opera and strengthening students' creative thinking and ability. Cheng Fang pointed out that the teaching team of traditional Chinese opera fully studied the teaching of traditional Chinese opera, searched for a large number of documents and materials, and analyzed the law of traditional Chinese opera teaching by way of tutoring. In Ref. [23], the author uses the idea of teaching and playing, uses mobile APP development, AR technology, and three-dimensional animation technology to design opera character scenes, and designs AR interaction that can effectively stimulate user's cognitive effect, reduce interaction function, and improve application effect. Inspired by the work of the aforementioned scholars, this article uses VR technology to stimulate students' learning initiative and complete drama science popularization education with rich and colorful teaching means. It first briefly introduces the concept and characteristics of AR technology. After that, it establishes the AR technology drama popular science application education model based on the statistical entity recognition algorithm and designs the drama popular science education app. Besides, it completes the drama animation design, character modeling design, drama scene design, logo pattern design, and animation design. Finally, from the two points of students' mastery of opera and learning opera knowledge, the actual use effect of this application is analyzed.

3. Materials and Methodology

3.1. AR Technology Overview. Augmented reality technology is abbreviated as AR technology. This technology uses computer technology to use virtual information in the real world by superimposing virtual objects in the same space or picture as the real environment. Augmented reality technology may deliver perceptual information that varies from human understanding and completely show real-world and virtual data. It accomplishes the goal of mixing virtual reality with augmented reality technologies by superimposing and augmenting two separate pieces of information, perfectly reflecting the features of three-dimensional registration and real-time interaction [24]. AR technology is based on video games and uses new technologies to strengthen what you hear, what you hear, what you hear, and what you feel, making the boundary between the computer-generated virtual world and the real world increasingly blurred. The spectrum between virtual reality and the real world is used to enhance the realization of the real world [25]. AR vision is that users use scanning to mark the objects to be recognized, to superimpose the dual visual feelings of "real" and virtual on the screen. Users use the intermediate medium of executing commands to enhance visual interaction.

AR technology is a virtual influence generated based on a computer system, which enhances the degree of users' perception of the real world. Generally, the implementation effect of this technology is related to the development of AR technology. Compared with traditional technology, this technology can provide users with the effect of immersing themselves in the virtual world. When using AR technology to design popular drama science applications, the basic principle is to fully integrate dynamic layout graphics, sound, and other sensory functions and static patterns. As a result, smooth connections between the actual and virtual worlds are achievable. When designing AR systems, there are several application programming interfaces and toolkits available, such as Mr tool, AR toolkit, and coin3d tool. When developing an AR drama popular science education application, the core engine is unity 3D, and the external connection with the Vu Foria package is employed [26]. The remarkable advantages of the Vu Foria tool are cross-platform and high editing efficiency. This technology locates the video detection function on the tag. Among them, the calibration accuracy of the tag tool and AR camera is higher. At the same time, it supports real scene fusion and specific graphic sound effects, video, and so on. When designing the application of drama popular science education based on AR technology, monitor-based technology is used. This technology has a simple function and implementation process and strong customer understanding and operability, and can meet the basic requirements of drama art lovers. The implementation process of the monitor-based augmented reality system constructed in this article is shown in Figure 1.

3.2. Components of AR Technology. Figure 2 depicts the major components of AR technology: hardware, software, and the remote server.

3.2.1. Hardware in Augmented Reality. Augmented reality devices are outfitted with CPUs, input devices, cameras, and displays. These are mini-supercomputers housed in tiny wearable devices. They demand a lot of computing power and include things like a processor, flash storage, RAM, GPS, GPU, Wi-Fi, and BT. Sensors positioned outside of the augmented reality gadget convey to the CPU the user's interaction with real-world elements. These sensors might be inertial sensors or gyroscopes on portable devices. Cameras are also put outside the gadget to scan the nearby surroundings and capture important data. These data are used by equipment that creates a virtual model to determine the right output. Mirrors are also utilized to help our eyes see the virtual picture more clearly. While several augment reality equipment features a variety of small curved lenses, others only have double-sided mirrors. This mirrors' one objects reflect light rays onto a camera, while the other side bounces light from a side mount screen to the eye. A mobile device, screen, head-mounted display (HMD), or spectacles can all be used as displays.

3.2.2. Software in Augmented Reality. The operation of augmented reality gadgets is heavily reliant on software. D'Fusion and other specialized 3D software are used to

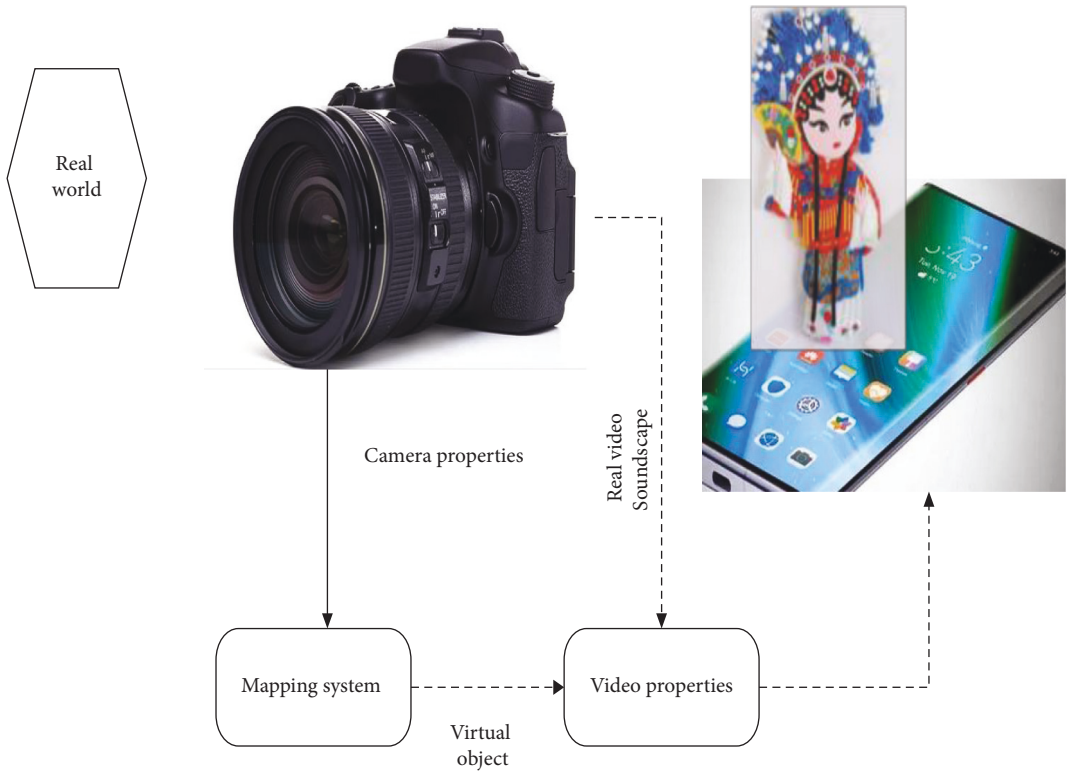

Figure 1: Implementation process of the monitor-based augmented reality system.

create augmented reality apps. Virtual pictures that overlay the real-world image are created using 3D software. Some instances are StudioMax, AutoCad3D, and Cinema 4D.

3.2.3. Remote Server in Augmented Reality. Aside from the hardware or software, an Internet or web server is utilized to keep a database for scanning virtual pictures. Virtual photos will be fetched from the database and given on to the querying augmented reality applications upon demand.

In education, augmented reality is utilized to create a common syllabus. Graphics, video, text, and music can be placed on the actual surroundings of the student. It has permitted the introduction of interactive reading tools that supply pupils with supplementary information. They may now engage with and understand their new surroundings. Augmented reality encourages remote collaboration by allowing teachers and students from many locations to communicate through a similar educational environment.

3.3. AR Technical Features. As we know, augmented reality (AR) is an improved representation of the real physical universe made possible by the use of electronic visual components, music, or other sensory stimulation given through technology. It is a developing trend among organizations active in personal technology and, in particular, commercial apps. With the advent of data collecting and analysis, one of the key aims of augmented reality is to emphasize certain elements of the physical environment, enhance knowledge of those qualities, and extract useful and accessible information that can be used for real-world applications. Big data may help organizations make better decisions and gain insight into customer spending habits, among other things. The key technical features of argumenta reality are explained in Figure 3.

3.3.1. Virtual Reality Superposition. Augmented reality technology is realized by superimposing and fusing virtual objects and reality, or further improved and improved based on the existing environment, which can better connect the virtual world and the real world, to improve the effectiveness of virtual reality fusion. The virtual reality mutual village technology can strengthen people's perception of reality and let users experience a new sense of super time and space, and the effect is enhanced.

3.3.2. Instant Interaction. With the rapid development of science and technology, the traditional single form of interaction cannot meet the basic needs of users. Users urgently need to use a real-time interaction mode. The emergence of augmented reality technology provides people with real-time interaction technology integrating virtual reality and real scenes. The overlay virtual and visible scene is presented by scanning the identification card using computer equipment. Under this scene, users can freely manipulate the virtual scene, strengthen the real-time interaction with users, strengthen the sense of immersion

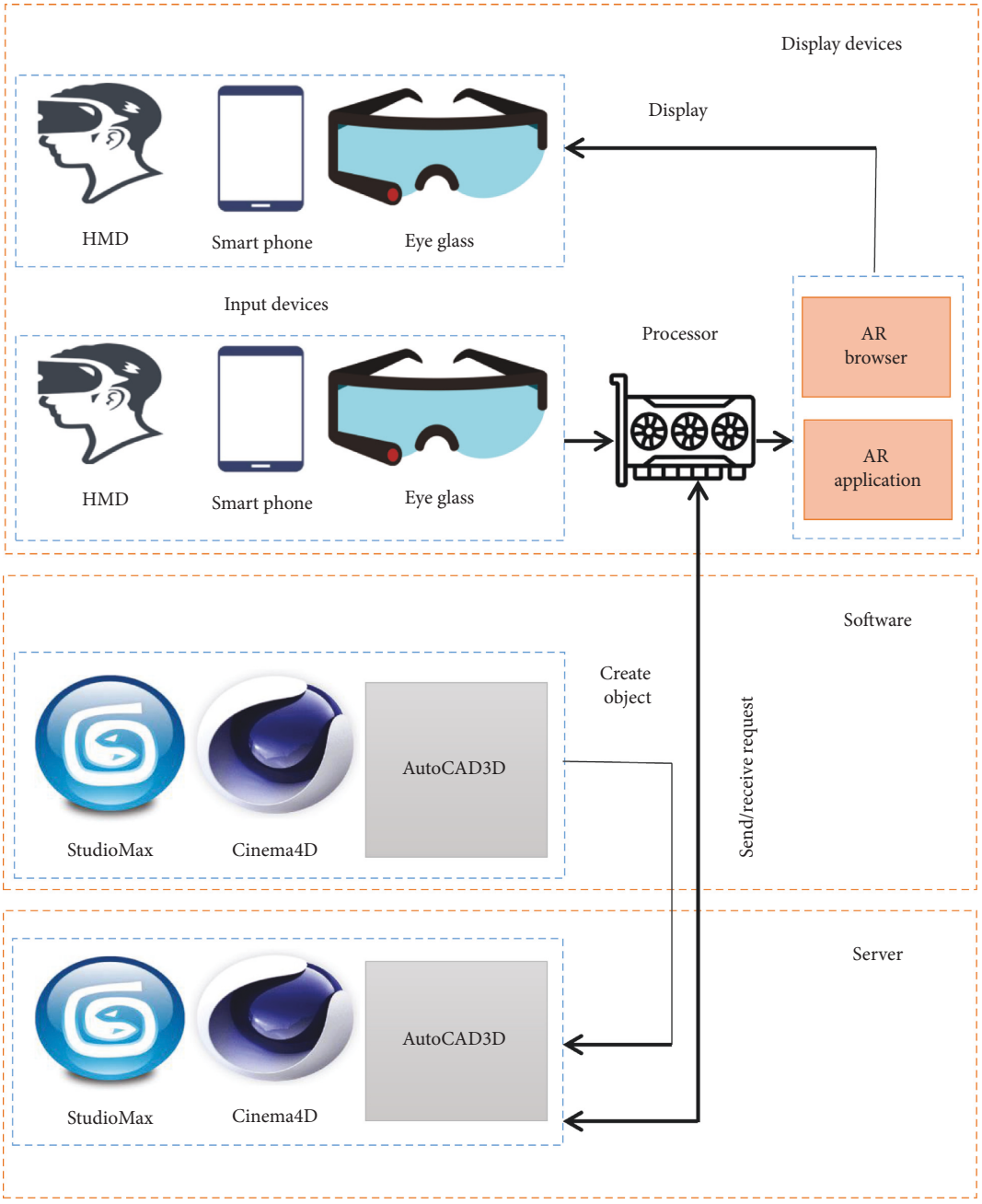

Figure 2: Components of AR technology.

and participation of users, and let users have more different interactive experiences.

3.3.3. D Tracking. The rapid development of AR technology effectively strengthens the recognition ability of AR application equipment. AR equipment's capacity to recognize entities has progressed from two-dimensional to three-dimensional. It can recognize the majority of real-world things. In addition, it can also compensate for the drawbacks of actual situations by strengthening virtual entities in three-dimensional space and replacing entities in real settings. Augmented reality (AR) technology offers more diverse expression techniques that can more thoroughly show multiscale virtual entities and alter virtual entities from numerous viewpoints, allowing for greater integration with the real world.

3.4. Entity Recognition Algorithm Based on Statistics. Entity recognition (ER) is a subfield of information extraction that searches for and categorizes certain objects inside a text or text. Natural language processing (NLP) and deep learning are two applications of ER in artificial intelligence (AI). To identify specific information, information extraction relies on ER, which employs models based on grammatical or mathematical analysis. Entities are initially recognized by ER as one of the various types, including

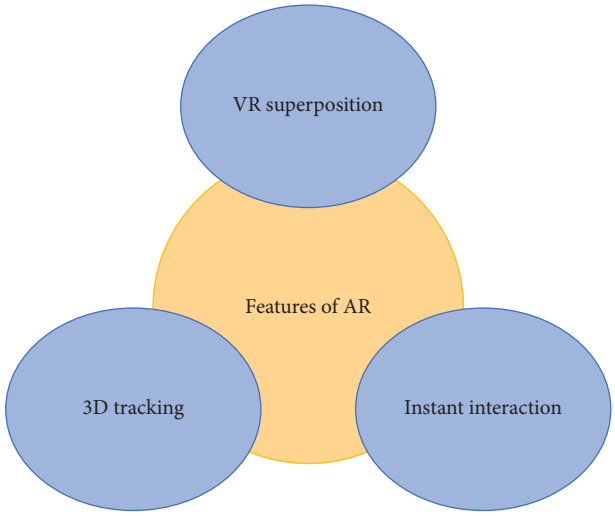

Figure 3: Technical features of AR.

individuals, locations, organizations, statements, proportions, and monetary values.

3.4.1. Hidden Markov Model. The hidden Markov system is a basic method that is used to describe or calculate the probability of any random process. It states that an observed event will not correlate to its step-by-step condition but is connected to a series of probability distributions. Suppose the system being represented is a Markov chain with certain hidden states. In such a situation, we may argue that hidden phases are a procedure that is dependent on the primary Markov process/chain. The primary purpose of HMM is to discover information about a Markov chain by examining its hidden states. Assuming a Markov process X with hidden phases Y, the HMM establishes that the probability of Y for each period must not be dependent on the history of X at that time.

At present, the hidden Markov model (HMM) is widely used in statistical entity recognition algorithms. It is a common statistical analysis model. It uses observable data to clarify the hidden parameters in this process and then uses this parameter for in-depth analysis. At present, it has become the main way of natural language processing, which is applied in the fields of behavior recognition, speech recognition, fault diagnosis, character recognition, and so on.

An HMM is made up of 2 stochastic processes: one invisible of hidden layers and one visible of observable symbols. The invisible hidden layers look similar to a Markov chain and the observed symbol's probability distribution are dependent on the underlying state. Let the hidden Markov model include two random processes, such as $\{x_k, y_k, k = 1, 2, 3\}$. Suppose $S = \{S_1, S_2, S_N\}$ is a state space, where $\{x_k\}$ is an unobservable finite state Markov chain, its transition probability matrix is unknown, and the Markov chain is a state chain, while $\{y_k\}$ is an observable chain, which is called Observation Company. Therefore, the main components of the model are (S, O, π, A, B).

3.4.2. Viterbi Decoding Algorithm. The Viterbi algorithm is a nonlinear programming algorithm for calculating the highest a probability reliable prediction of the most likely series of hidden states, known as the Viterbi route, those outcomes in a series of observed events, particularly in the context of Markov information sources and hidden Markov models (HMM). On the other hand, a Viterbi decoder employs the Viterbi algorithm to decode a stream of bits encoded utilizing a convolutional code or trellis code.

After the model parameters are determined, the next step is decoding, which is the observation sequence and model $\lambda = (\pi, P, Q)$ is certain. Use $v = \{v_1, v_2, v_3, \ldots v_i\}$ to calculate the model $\lambda = (\pi, P, Q)$, and generate the most likely state in the model $x = \{x_1, x_2, x_3, \ldots x_i\}$, inferring the true state of the hidden layer.

The Viterbi algorithm uses forward and backward algorithms to decode and define the path optimal variable and then uses recursive iteration to reduce the amount of calculation. The following is the path optimal variable:

$$\delta_t(i) = \max_{X_1, X_2 \ldots X_{t-1}} P\{X_1, X_2 \ldots X_{t-1}, X_t = S_i, v_1, v_2, \ldots v_i \mid \lambda\}. \quad (1)$$

According to the previous equations, t followed by $X_1, X_2, \ldots, X_{t-1}, X_t$ path, t moment state can be expressed as X_t equal to S_i, generating $V_1, V_2, \ldots$. The probability of V_t observation sequence is the highest. The best possible state transition in S_i at time t is defined when finding the path. Figure 4 explains the flowchart of this algorithm.

(i) *Initialization*. The process of identifying and utilizing the significant measure for variable data used for a computer program is known as initialization. Assuming that the value of t is 1 and I is less than or equal to N, and that there is only one observation and state value greater than or equal to 1, and then, t is the maximum value itself. This can be calculated using the following equation:

$$\delta_t(i) = P\{X_1 = S_i, v_1 \mid \lambda\} = \pi_i q s_t v_t, \quad (2)$$

where state of the S_t is initial and there is no state transition, which can be recorded as $\delta_1(i) = 0$.

(ii) *Recursion*. If $1 < i < N$, $2 < t < n$, $t - 1$ follows $X_1, X_2, \ldots$ At any time, X_{t-1} path by $\delta_{t-1}(j)$ indicates that the state X_{t-1} at $t - 1$ moment is equal to that of S_i, and the resulting $V_1, V_2, \ldots$ The probability of V_t observation sequence is the highest, and $1 \le j \le N$. $\delta_t(j)$ T based on $\delta_{t-1}(j)$ is formed by moving one step to the right. There are N types of states produced by moving one step. Use (3) to calculate the maximum value:

$$\delta_1(i) = \max_{\le 1 j \le N} P\left\{\delta_{t-1}(j) p_{s_j s_i} q_{s_i v_t}\right\}. \quad (3)$$

After extracting items that are not related to j, we can get the following:

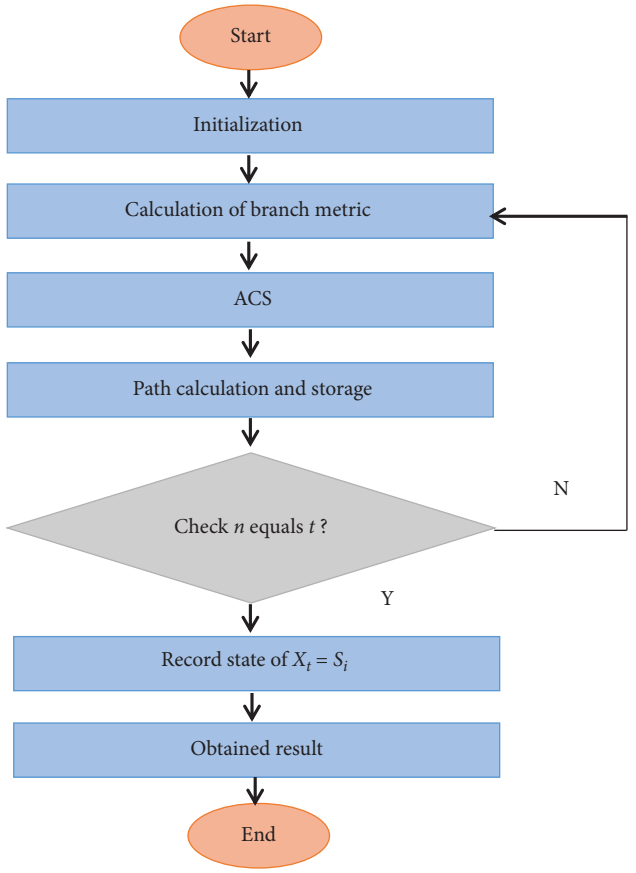

Figure 4: Flowchart of the Viterbi decoding algorithm.

$$\delta_1(i) = q_{s_i v_t} \max_{\le 1 j \le N} \left\{ \delta_{t-1}(j) p_{s_j s_i} \right\}, \tag{4}$$

where we record the origin of $X_t = S_i$:

$$\delta_t(i) = \operatorname{argmax}_{\le 1 j \le N} P \left\{ \delta_{t-1}(j) p_{s_j s_i} \right\}. \tag{5}$$

(iii) *Termination Condition*. A termination condition is just an expression or a mathematics equation that limits or defines movement by using constants, variables, operators, and shared functions. Here the condition for the proposed algorithm is checked for n equal to t, as shown by the following equation:

$$\delta_n(i) = q_{s_j s_i} \max_{\le 1 j \le N} \left\{ \delta_{t-1}(j) p_{s_j s_i} \right\}. \tag{6}$$

The record state of $X_t = S_i$ is formed by the transition from $t = 1$ moment to time:

$$\delta_n(i) = \operatorname{argmax}_{\le 1 j \le N} P \left\{ \delta_{n-1}(j) p_{s_j s_i} \right\}. \tag{7}$$

The following represents the optimal probability:

$$P^* = \max_{1 \le j \le N} (\delta_n(j)). \tag{8}$$

The n-time state is recorded by the following equation:

$$\delta_n^* = \operatorname{argmax}_{1 \le j \le N} (\delta_n(j)). \tag{9}$$

4. Design of Opera Popular Science Education Based on AR Technology

4.1. APP Design of Opera Popular Science Education Based on AR Technology. This article designs the application of popular science education in opera based on AR technology, in which the main carrier of information exchange is APP [27]. The technique of employing AR stereo pictures in the creation and development of popular scientific teaching of opera is explained in this research. After downloading and installing the APP on a mobile platform and scanning the still image, a virtual three-dimensional image will appear on the device screen, as illustrated in Figure 2. When APP scans a still picture, it examines it to see when it satisfies the desired specifications. Specific sound effects and graphics should be added to the relevant database in advance while constructing an APP. Users can proceed with the download of APP software and the preparation after enrolling or activating the program. Based on AR technology, the design of the Opera Education APP can recognize a series of specific opera art features, such as stage, role, and decorative patterns. The design functions include the following:

(i) Image scanning and AR enhance the 3D dramatic stereo animation effect [28]

(ii) Achieving the matching of opera scenes, lyrics, and music

(iii) 360-degree panoramic rotation with functions of zooming out and zooming in

(iv) Intercept specific animation scenarios and share them with other friends

(v) Change the costume of the characters and realize the interaction of the artistic roles of the plays

(vi) Enhance the entertainment of traditional Chinese opera art

Figure 5 shows the design process of popular science application of opera based on AR.

4.2. Enhancement of Functional Interaction. Based on Unity 3D and Vu Foria SDK, this article designs a popular science application of mobile AR opera by using the Vu Foria SDK resource pack to track 2D patterns with identification markers. After that, it combines iOS mobile devices with Android touch screens to generate virtual, real, and interactive two-degree cross-fusion, which can enhance the display effect of an interactive experience.

4.3. Dramatic Animation Design. This article uses Unity 3DAR to design opera animation, involving the design of opera character scenes, role modeling, special effects, and animation design. In the design process, the overall design effect should be analyzed and the interestingness highlighted. The opera characters designed are funny and

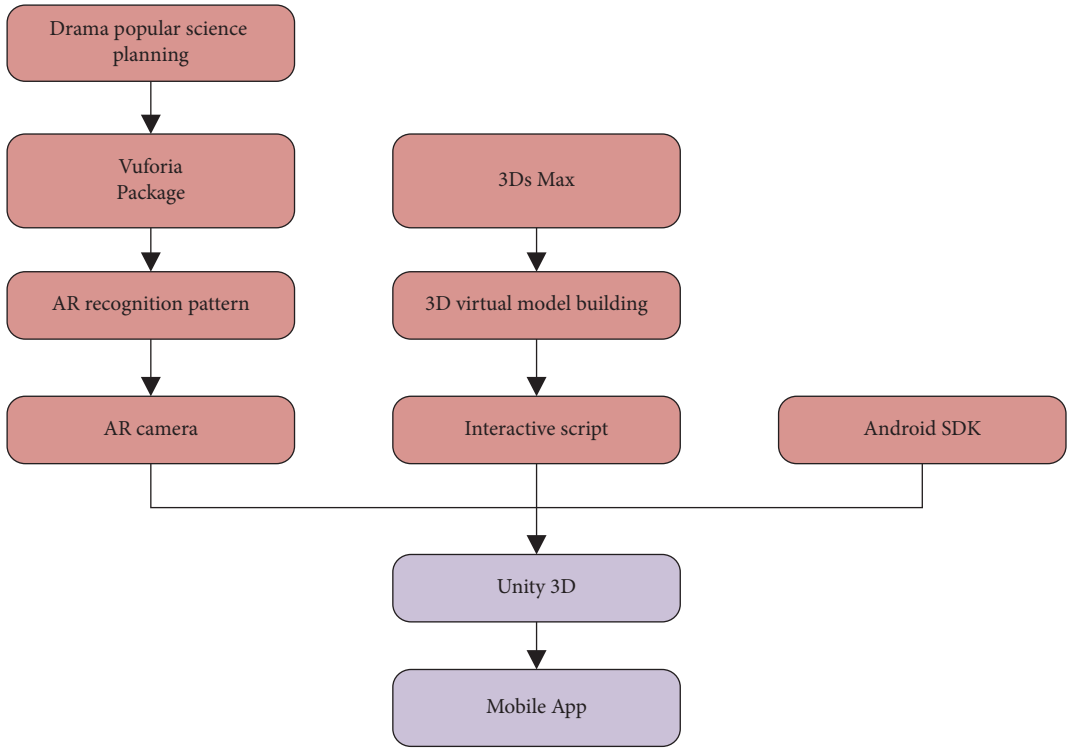

Figure 5: The design process of popular science application of AR opera.

humorous to meet the aesthetic requirements of the popularity. The new and interesting design of the opera can attract more users and play a role in teaching and enjoying. The application of Augmented Reality (AR) technology can enhance convenience, and beginners can learn better. The main contents of the animation design of opera are explained in Figure 6.

4.3.1. Designing the Role Style of Opera. The general impression of traditional opera art is stereotyped, stylized, and rigid characters. Therefore, most people should use the role style design when designing the opera style. This study explores the cartoon characters of AR Opera based on the lessons and pleasures creates in the cartoon forms. For this purpose, this research work follows the basic principle of designing the proportion of roles: the two-body shapes of a big head and small body, and the role clothes are classified according to the different scenes of the opera.

4.3.2. Designing Opera Scenes. Traditional opera performances must be finished on a permanent stage, and audience members can only see them in that setting. The opera scenes made using AR technology may be redesigned and developed from the tale scenes, capturing the complete immersion and presence of the opera sceneries.

4.3.3. Designing Identity Patterns. Based on AR technology, popular science education application design of opera should be divided into different forms when designing and identifying patterns. This article takes the classic sections of Huangmei Opera as blueprints to complete four sets of AR-pattern designs. By identifying two categories of Huangmei Opera, two representative patterns are selected, which meet the requirements of diverse artistic types and styling characteristics of the opera. Enter the mobile phone client again and open the APP to scan the static pattern; the page can display the image of the opera and different stage scenes. After the opening of the opera animation, the music gradually shows its effect. While viewers enjoy the art of the opera, they can also learn more classical Chinese opera poems.

4.3.4. Animation Design. The animation of traditional Chinese opera should be completed according to the accuracy and fluency of the action. When collecting and optimizing the action, it should be analyzed from the aspects of a body, sleeve, law enforcement, etc. The symbolic nature of traditional Chinese opera actions makes them more artistic, and they are the main part of the aesthetic expression of traditional Chinese opera. For example, sailing, walking, mountains, hegemony, and running city in the opera all reflect the dancing characteristics. Therefore, Keyframes should not be used when designing actions. Standardized and standardized action data should be collected. Create a database of opera animations by capturing the movements and processing of professional opera dancers, and then bind it to the three-dimensional virtual characters of the opera. This article uses light motion capture technology to collect dance data of Huangmei Opera, uses Motion Builder to optimize data, and integrates animation data and 3D characters based on 3D sMax 3D animation software.

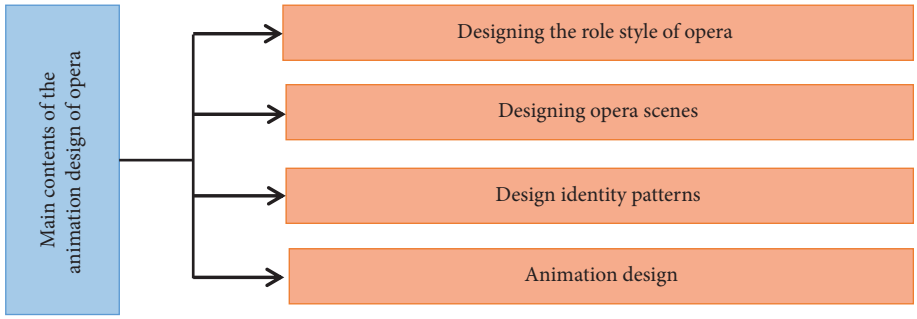

Figure 6: Main contents of the animation design of opera.

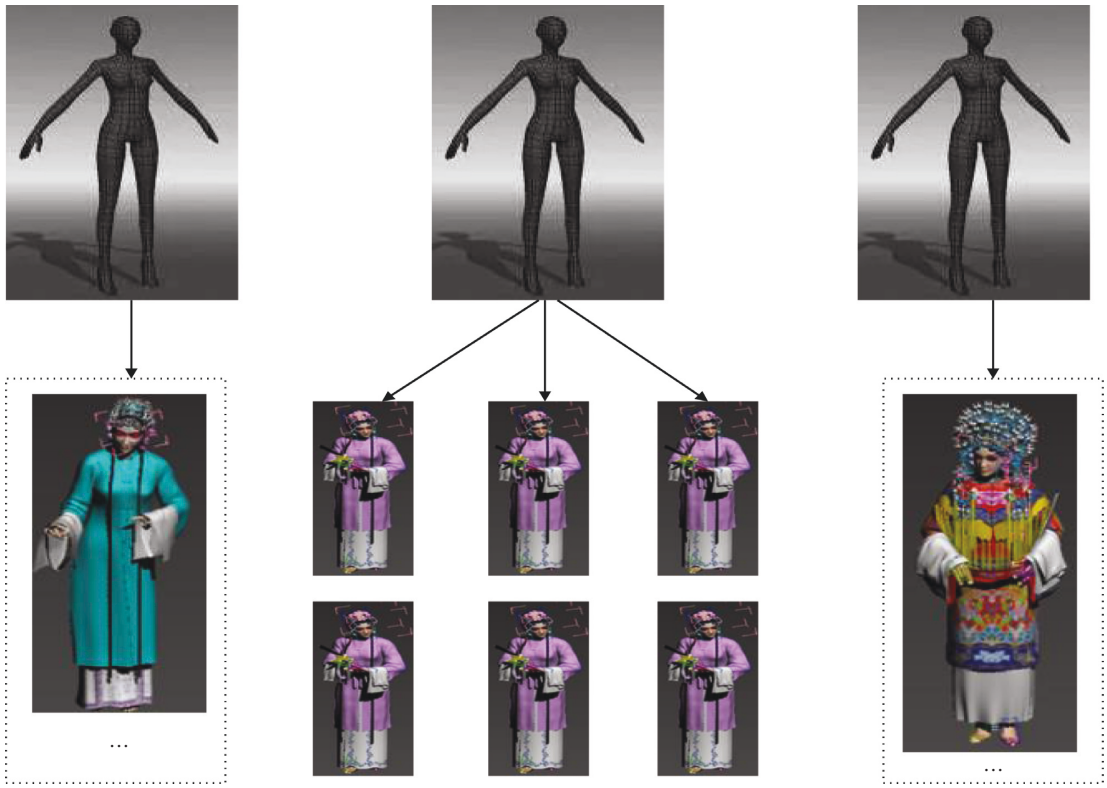

Figure 7: Opera animation database framework.

Compared with the general animation creation method, this motion capture technology can convert the motion data, which greatly improves the efficiency of motion capture without increasing the production costs. It is suitable for building large opera dance action database. Figure 7 is the technical framework of the motion database.

5. Analysis Results of Popular Science Education in Opera

5.1. An Analysis of Students' Mastering of Opera. This article designs a popular science education application of opera based on AR technology and uses it in the actual opera classes. To test the actual effect of this application, a student of an opera school is selected as the research object, starting from three aspects: performance of the opera body, mastering the number of opera segments and mastering the basic

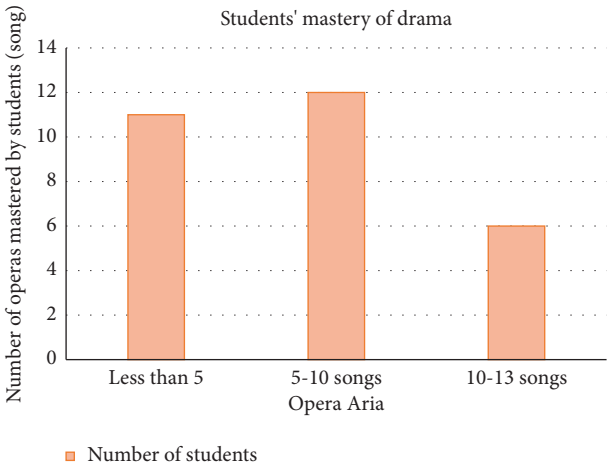

Figure 8: Student opera mastery.

Table 1: Students' master number of albums.

Number of students	Aria name	Number of aria
23	All tracks	6
2	"Drunken Imperial Concubine," Liang Shanbo and Zhu Yingtai "Daughter in Law," "Celestial Match"	4
5	"Drunken Imperial Concubine," "Liang Shanbo and Zhu Yingtai" "Daughter in Law," "Celestial Match," "A Dream of Red Mansions"	5

Table 2: The quality of performance.

Number	Lyrics	Melody	Emotional input	Body movement
1	Relatively clear	Unfamiliar with some paragraphs	Input section selection	Some actions are not in place
2	Partially clear	More familiar	Not very involved	Some actions are not in place
3	Part unclear	Unfamiliar with some paragraphs	General input	Some actions are not in place, Even forget

knowledge of opera. According to the survey data, 6 students of the Opera School can master 10–13 opera segments, 12 students can master 5–10 opera segments, and 11 students can master less than 5 opera segments. The statistical results are shown in Figure 8.

In the course of section teaching, we should learn opera knowledge, mainly including the characteristics of opera singing, the development of opera genres, and the explanation of classical sections in opera [29]. Traditional Chinese opera body movements include basic performance actions, and most students learn independently by watching opera videos. This article analyzes opera education in the opera school from 2019 to 2020 to confirm the data's authenticity and scientificity. To guarantee the authenticity and scientificity of the data, students study six new opera segments, namely, the Beijing opera tracks "Farewell My Concubine," "Imperial Drunken Princess," "Dream of Red Chamber," "Liang Shanbo and Zhu Yingtai" over-opera tracks, "Puma," and "Tian Xian Pai" Huang Mei opera tracks. This article selects 30 students from the Opera School, 24 of whom can master these six opera tracks skillfully in one year. Student's master number of albums can be explained in Table 1.

Three students in Table 2 above are unfamiliar with opera melody, lyrics, emotional expression and body movements, less emotional input and nonstandard movements, and even forget lyrics and body movements.

5.2. An Analysis of Students Learning Opera Knowledge. The opera school uses the popular science education application of opera based on AR technology design to analyze the situation of students learning opera knowledge. According to the survey data, 42% of students said they mastered opera singing in the opera class, such as "Four Gong Five Methods" and "Qichen Dantian"; 23% of the students indicated that they could master a large number of other types of operas, including Huangmei Opera, Beijing Opera, and Yuyu Opera, after applying AR technology to the teaching of popular opera science. Eighteen percent of students said they could learn and master the body and action of opera performance. 10% and 7% of students said they could master more opera knowledge in the opera class. The statistics are shown in Figure 9.

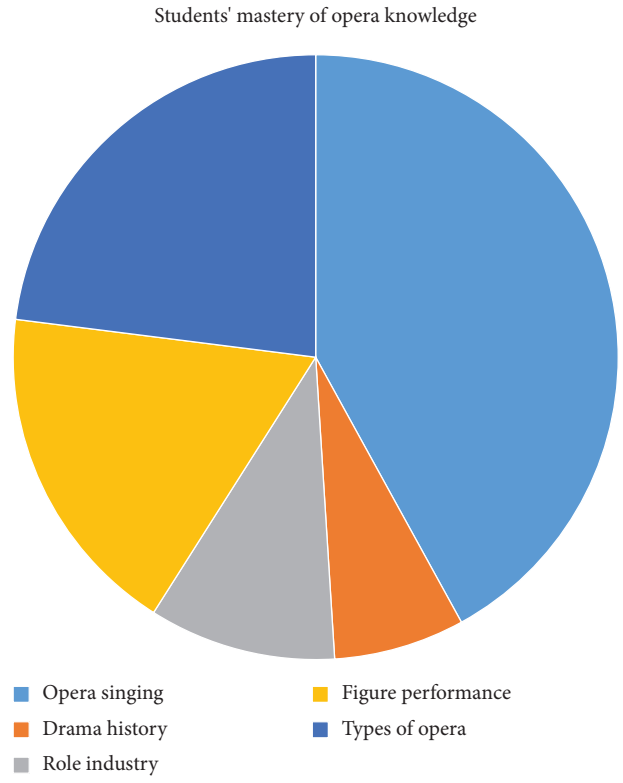

Figure 9: Students master opera knowledge.

5.3. An Analysis of Students' Learning Styles of After-School Opera. This article analyzes the way students learn Chinese opera after class. 60% of them say that they will practice after class when they learn the acting actions and singing passages of Chinese opera, and look up the data of Chinese opera in the application according to the teacher's requirements. 29% of students will learn opera videos independently after class watch and browse the video of opera selections. Only two students will learn opera from primary school and communicate with the opera teacher to learn opera [30] after class. 7% of students will learn opera in other ways, such as watching a competition and performing. Figure 10 shows the statistical results of the way students learn opera after class.

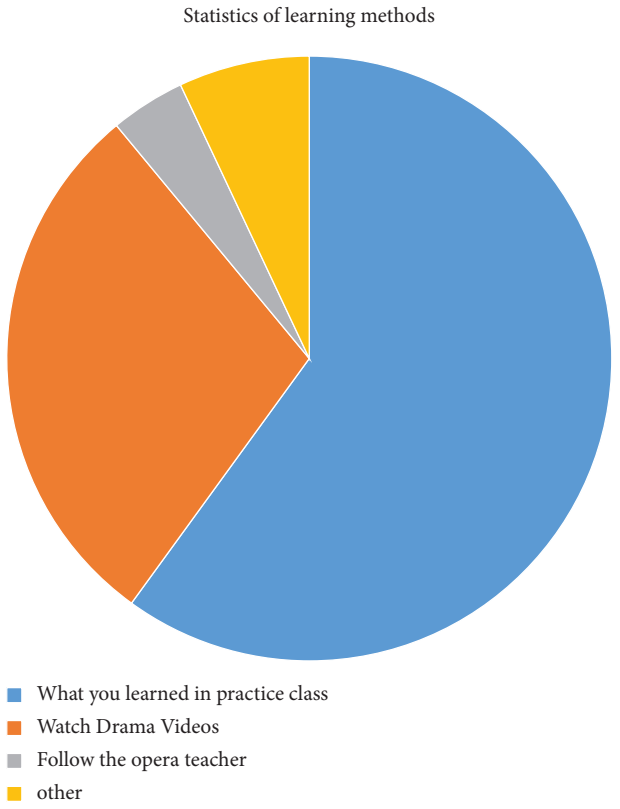

Figure 10: Statistics of learning methods.

6. Conclusions

In recent years, there are many popular science education products developed based on AR technology. However, AR technology is rarely used in drama popular science education, and there are few products developed. Traditional opera popular science education adopts a single way of teaching, the classroom teaching process is boring, and the efficiency and quality of students' Opera learning are low. Therefore, this article uses VR technology to stimulate students' learning initiative and complete drama science popularization education with rich and colorful teaching means. This article first briefly introduces the concept and characteristics of AR technology, establishes the AR technology drama popular science application education model based on the statistical entity recognition algorithm, designs the drama popular science education app, and further completes the drama animation design, character modeling design, drama scene design, logo pattern design, and animation design. Finally, from the two points of students' mastery of opera and learning opera knowledge, the actual use effect of this application is analyzed. Among them, 42% of the students can better master the singing method of drama, 23% of the students say they can master other types of drama, 18% of the students can better learn and master the movement and figure of drama, and 10% and 7% of the students can master a lot of drama knowledge. This fully proves the effectiveness of this application in practical opera teaching, which is of great help to improve the quality and effect of opera teaching [31].

Data Availability

The datasets used and/or analyzed during the current study are available from the author on reasonable request.

Conflicts of Interest

The author declares that there are no conflicts of interest for the publication of this article.

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