

## *Retraction*

# **Retracted: Building English Audio-Visual and Oral Mobile Teaching System Based on Virtual Augmented Reality Technology**

### **Wireless Communications and Mobile Computing**

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This article has been retracted by Hindawi following an investigation undertaken by the publisher [1]. This investigation has uncovered evidence of one or more of the following indicators of systematic manipulation of the publication process:

- (1) Discrepancies in scope
- (2) Discrepancies in the description of the research reported
- (3) Discrepancies between the availability of data and the research described
- (4) Inappropriate citations
- (5) Incoherent, meaningless and/or irrelevant content included in the article
- (6) Peer-review manipulation

The presence of these indicators undermines our confidence in the integrity of the article's content and we cannot, therefore, vouch for its reliability. Please note that this notice is intended solely to alert readers that the content of this article is unreliable. We have not investigated whether authors were aware of or involved in the systematic manipulation of the publication process.

Wiley and Hindawi regrets that the usual quality checks did not identify these issues before publication and have since put additional measures in place to safeguard research integrity.

We wish to credit our own Research Integrity and Research Publishing teams and anonymous and named external researchers and research integrity experts for contributing to this investigation.

The corresponding author, as the representative of all authors, has been given the opportunity to register their agreement or disagreement to this retraction. We have kept a record of any response received.

### **References**

- [1] D. Xinzhen and R. Zhifen, "Building English Audio-Visual and Oral Mobile Teaching System Based on Virtual Augmented Reality Technology," *Wireless Communications and Mobile Computing*, vol. 2023, Article ID 1387219, 13 pages, 2023.

## Research Article

# Building English Audio-Visual and Oral Mobile Teaching System Based on Virtual Augmented Reality Technology

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Aiming at the problem that the current English textbooks still provide video materials in the form of CD-ROMs, which affects the learning effect, a research method of English audio-visual mobile teaching system based on virtual and augmented reality technology is proposed. The system first builds a recognition map database and stores it in the cloud and names the corresponding video files according to the name of the recognition map, then uses Unity3D to design and render the scene, design the virtual video playback button of the ImageTarget object, and write script code to realize the recognition map database and its corresponding video, access, and finally, generate a user-friendly mobile application. Users only need to point the lens at the book illustration to present the visual effect of superposition of virtual and real and realize the playback of English teaching videos on mobile devices. The results show that compared with the original image grayscale distribution map, the pixels near the 0 value of the pixel distribution map after twice filtering are significantly reduced, which reduces the hole noise of the image, and the original image and the image after twice filtering are not 0. The peak value of the pixel is close, maintaining the detailed characteristics of the image. The application of augmented reality technology to English video teaching enables users to enjoy novel learning methods and an interactive experience combining virtual and real.

## 1. Introduction

In the information age, many universities still do not use advanced information technology in the process of teaching English listening and speaking in the classroom, but rely solely on offline teaching and do not know how to change from the traditional teaching method to the mobile micro-learning method. This teaching method has great drawbacks. On the one hand, the classroom time is limited, and students have no time to digest the new knowledge they have learned. On the other hand, the spare time is not fully utilized, resulting in the waste of a lot of learning resources. English audio-visual teaching mainly trains the ability of listening, speaking, reading, and writing, and the cultivation of this ability requires a lot of repetitive practice; obviously, there is not such sufficient time in the classroom. If the students simply listen to the teacher's teaching and do not practice by themselves, it is difficult for them to master the skills of college

English audio-visual skills. There is another problem; some students are diligent in thinking; they will have many problems, but the class time is limited, and many problems cannot be solved. Faced with this situation, we need our teachers to actively seek solutions. This problem can be effectively solved by the combination of real classroom and online classroom, and the mobile teaching system is created based on this solution. With the development of network technology and the widespread popularization of mobile smart devices, mobile learning has gradually become popular in school teaching. Combining the convenience, practicability, and efficiency of mobile devices with college English audio-visual teaching, the construction of a mobile audio-visual teaching mode of big English is the main direction of modern college English audio-visual teaching reform.

The application of virtual and augmented reality technology in college English audio-visual teaching is becoming more and more extensive, especially the function of English

network platform is becoming more and more powerful. Reform the traditional classroom-style college English teaching mode, establish a new model of English audio-visual mobile teaching based on virtual and augmented reality technology, and integrate virtual and augmented reality technology into college English audio-visual teaching, to achieve the goal of college English audio-visual teaching.

Augmented reality is also called hybrid reality technology. The technical principle is to simulate the physical information that is difficult for people in a certain range of time and space, such as visual information, sound information, taste information, and tactile information, with the help of scientific technology. The technical principle is the project risk prevention mechanism, which is the law or standard based on in the implementation of the project, usually based on the experience of past failures. Then, it is superimposed into the real world through certain technical transformation, so that it can be felt by our organs and can make people feel or even surpass the sensory experience of reality. Through the sensory organs, we can know the colorful world. Compared with traditional virtual reality technology, augmented reality technology achieves more different immersive effects. It can organically combine the information generated by computer with the scenes in the real world, to provide more accurate and efficient auxiliary operation interface for users in medical and engineering fields [1]. The combination with mobile teaching system can reflect the cloud data, including text, video, and other information in real time in mobile devices with the help of mobile network, present a more real visual effect with the help of virtual augmented reality technology, and give users a more novel English audio-visual and oral learning method.

## 2. Literature Review

Many universities in the United States use virtual reality equipment to publicize campus culture. They will record a panoramic introduction of the campus and send it to students preparing for admission, to help freshmen adapt to campus life in advance and better understand campus culture [2]. Despite Google's efforts to promote, virtual reality technology still cannot be popularized on a large scale in colleges and universities in various countries [3]. Leading universities in various countries have not widely applied VR technology in the classroom, and some of them believe that VR technology is not the core of teaching, and it is difficult to apply VR to all courses due to the factors of teaching methods and situations; they believe that, for example, language and literature courses are different from professional courses such as architecture, physics, medicine, and biology, and there is no demand for VR technology. The high-tech industries vigorously developed by the country listed in the outline of the 13th five-year plan for national economic and social development of the People's Republic of China issued by the national two sessions in 2016, including innovation and industrialization in emerging frontier fields such as robots, aviation equipment, intelligent transportation, virtual reality, and interactive film and television; as a new technical field, virtual reality is developing at a very fast speed

[4]. The guidance of national policies and practical needs has stimulated a virtual reality entrepreneurial boom, and the relevant entrepreneurial teams have increased explosively. The research report released by the National Advertising Research Institute and several institutions shows that the virtual reality user group has a trend of spreading from the first tier cities to the whole country. China joined the research ranks of virtual reality technology only in the 1990s, but with the rapid development of computer field in China in recent years, it also drives the development of virtual reality technology [5].

In recent years, the large-scale attempts in commercial projects have made virtual reality stand out. With the continuous maturity of technology, the space art of virtual reality is a new form of artistic language combining sculpture, painting, image, and other media. Virtual reality has a wide range of applications, but it is still in the exploratory stage. Virtual reality technology involves electronic technology. At the same time, it needs to apply the knowledge of visual perception, physiology, psychology, ergonomics, and other disciplines. Virtual reality should be promoted from the technical level to the artistic level. Its research and practical application in the field of art is an urgent need to explore. In recent years, virtual reality research boom broke out in China, and many related research companies appeared, but few developed in the field of Education [6]. As a concept stock on the tuyere, virtual reality is still expected to make huge profits in games and film and television. The application of virtual reality in education has been thunderous, but the rain is small. The intention of "immersive education" and "virtual education" of LETV China is reached. At the product launch site of LETV, the CEO of New Oriental said that the panoramic teaching environment created by virtual reality technology can enable students to "immerse learning" and improve learning efficiency in English classroom. From the virtual reality video launched by LETV, it can be seen that wearing the head mounted virtual reality display, learners will have the feeling of being in it. They can watch the virtual classroom 360° and enhance students' understanding of the classroom learning environment and experience effect [7].

## 3. Virtual Augmented Reality Technology

### 3.1. Augmented Reality Technology

*3.1.1. Working Framework of Augmented Reality System.* A complete augmented reality system framework should include six main functional modules, namely, scene acquisition, target recognition and tracking, target registration, virtual real fusion, virtual real interaction, and image display. Its workflow is shown in Figure 1.

*3.1.2. Target Recognition, Tracking, and Registration Technology.* The tracking registration technology based on computer vision uses algorithms such as image recognition to obtain the position of the target in the real scene in real time, so as to realize the function of target tracking. The tracking registration technology combining computer vision

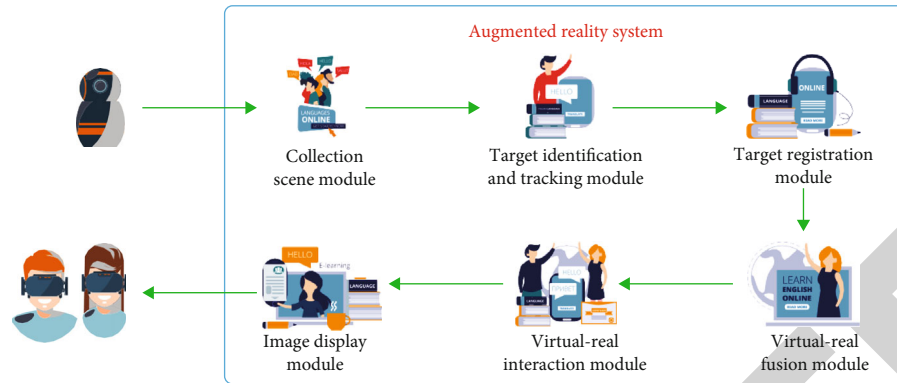


FIGURE 1: Framework of augmented reality system.

and tracking sensor combines the advantages of both, which not only has the advantages of sensor in outdoor environment but also includes the dynamic tracking function of real scene. In the technology of target tracking and recognition, many researchers outside China are constantly improving the efficiency of target recognition and tracking.

**3.1.3. Display Technology.** The development direction of augmented reality is mostly concentrated in the field of vision. Common display terminals include PC screen display, mobile screen display, and projection display equipment. Among wearable devices, there are mainly helmet-mounted display and spectacle display devices; wearable devices are represented by smart watches and wireless headphones. The rapid development of wireless technology has driven the maturity of wearable ecology, making wearable devices enter the rising stage. There will be various forms of products derived from the market, such as smart glasses, AR, and VR technology, and helmet-mounted display can be subdivided into projection helmet-mounted display, free-form surface helmet-mounted display, and so on.

**3.1.4. Augmented Reality Interactive Technology.** Augmented reality interaction technology has changed the traditional way of human-computer interaction. Users can send instructions and obtain responses to the computer without the help of hardware equipment and realize the communication between human and computer through the interaction and control of virtual objects. If there is no ready hardware device, it can be simulated by downloading the network debugging assistant. The realization of augmented reality interaction technology is based on target recognition, tracking, and registration [8, 9]. According to the dependence on hardware, augmented reality interaction technology can be roughly divided into two types. The first is to obtain video stream or image only by using image input device and identify and register the target according to the system design, so as to obtain the target in the natural scene, and it is mainly used for rapid target detection, especially in some edge devices, such as autonomous driving. Unmanned vehicles, etc., need to quickly identify and feedback the obtained images and videos for the control system to respond quickly.

The second is to assist the detection and recognition of targets with the help of data gloves and wearable sensing devices. At the same time, the user's instructions can be detected by hardware sensing.

According to the position relationship between virtual objects and real objects in space, multichannel augmented reality interaction technology can be divided into interaction modes with depth consistency and interaction modes without depth consistency [10, 11]. Augmented reality interaction based on depth consistency can present the correct position relationship (depth information) between real objects and virtual objects in the same scene; augmented reality uses various techniques for presentation, including optical projection systems and monitors and realizes the mutual occlusion between virtual objects and real objects. This interaction technology is commonly used on configurable binocular cameras, depth cameras, and other devices that can obtain the depth of the scene. Virtual objects have depth data and can achieve perspective effects in real scenes. With the help of 3D reconstruction and collision detection technology, it can block each other with the targets in the real scene, to realize the interaction based on depth consistency, make the interaction mode closer to nature, and make the interaction effect between virtual objects and real scenes more realistic. According to the instruction mode, the instruction-based augmented reality interaction technology can be divided into static instruction interaction and dynamic instruction interaction [12, 13]. Static instruction interaction is to transfer the information such as manual identification code, human hand, or human body static action to the system, obtain the static instruction through the identification and detection algorithm, and feed back the instruction information to the system, so as to make the system respond. Dynamic instruction interaction is to take the image recognition instruction in consecutive frames with timing information as information and feed back the result to the system. The difference between static instruction interaction and static instruction interaction is that static instruction interaction can obtain one frame information in a scene film or video as data, while dynamic instruction system needs to obtain images of continuous frames, such as somatosensory action recognition.

**3.2. Calibration Technology of Augmented Reality.** When the virtual object is registered in the real scene, it needs to maintain an accurate alignment relationship with the real scene in real time. Therefore, it is necessary to calibrate the camera. Camera calibration is the process of solving camera internal parameters, external parameters, and distortion parameters. Camera internal parameters include camera focal length ( $f_x, f_y$ ), principal point coordinates ( $c_x, c_y$ ), and distortion factor  $\lambda$ . External parameter matrix includes rotation matrix  $R$  and translation vector  $T$ , and distortion parameters include  $[k_1, k_2, p_1, p_2]$ , as shown in Table 1 [14, 15].

**3.2.1. Coordinate System and Camera Model.** In augmented reality system, four coordinate systems are involved, which are world coordinate system, pixel coordinate system, camera coordinate system, and image coordinate system. The objects in the real scene are transformed from the world coordinate system to the camera coordinate system in the form of optical signals and finally presented to the pixel coordinate system. The relationship between the three coordinate systems is shown in Figure 2.

The scene entering the camera in the real scene can be described as the conversion relationship between the world coordinate system and the camera coordinate system. In order to determine the location of the camera in the real scene and describe the attitude and orientation of objects in space, it is necessary to set a coordinate system in space. Cameras and space objects are different. Space object determination is based on the direction of an absolute coordinate system and three axes relative to the inertial system, but the camera is more complex because the camera needs to determine the position and the direction of the line of sight. The conversion relationship between camera coordinate system and world coordinate system is shown in

$$\begin{bmatrix} x_c \\ y_c \\ z_c \end{bmatrix} = R \begin{bmatrix} x_w \\ y_w \\ z_w \end{bmatrix} + T. \quad (1)$$

The projection relationship formula between the image coordinate system and the camera coordinate system is shown in

$$Z_c \begin{bmatrix} x \\ y \\ 1 \end{bmatrix} = \begin{bmatrix} f & 0 & 0 \\ 0 & f & 0 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} X_c \\ Y_c \\ Z_c \end{bmatrix}. \quad (2)$$

After the camera obtains the image data in the real scene, it needs to present the image on the display terminal to form a digital image. Let the physical size of the unit pixel be  $\Delta x$  and  $\Delta y$  in the  $x$ -axis direction and  $y$ -axis direction, respectively, and the conversion formula from pixel coordinate

TABLE 1: Camera parameters.

Parameter	Parameter formula	Number of parameters
Internal parameters	$K = \begin{bmatrix} f_x & \lambda & u \\ 0 & f_y & v \\ 0 & 0 & 1 \end{bmatrix}$	6
External parameters	$R = \begin{bmatrix} r_1 & r_2 & r_3 \\ r_4 & r_5 & r_6 \\ r_7 & r_8 & r_9 \end{bmatrix}$ $T = \begin{bmatrix} t_1 \\ t_2 \\ t_3 \end{bmatrix}$	7
Distortion parameters	$[K_1, K_2, P_1, P_2]$	3

system to image coordinate system is shown

$$u = \frac{x}{\Delta x} + u_0, \quad (3)$$

$$v = \frac{x}{\Delta y} + v_0. \quad (4)$$

The relationship between pixel coordinate system and image coordinate system is shown in Figure 3.

**3.2.2. Camera Calibration.** The calculation process is as follows: firstly, a homography matrix  $H$  can be calculated for each calibration board image collected by the camera, in which the parameter  $\lambda$  is constant and not 0, and the parameters  $r_1$  and  $r_2$  are two unit vectors of the image plane in the world coordinate system, which are orthogonal to each other, in which the parameter  $k$  is the internal parameter matrix of the camera, and the relationship is shown in

$$H = [h_1 \ h_2 \ h_3] = \lambda K [r_1 \ r_2 \ t]. \quad (5)$$

The parameter matrix  $K$  in the camera can be written in the form of

$$h_1^T K^{-T} K^{-1} h_2 = 0, \quad (6)$$

$$h_1^T K^{-T} K^{-1} h_2 = h_2^T K^{-T} K^{-1} h_1. \quad (7)$$

Set:

$$A = K^{-T} K^{-1}. \quad (8)$$

Write the matrix as shown in

$$A = K^{-T} K^{-1} = \begin{bmatrix} A_{11} & A_{12} & A_{13} \\ A_{21} & A_{22} & A_{23} \\ A_{31} & A_{32} & A_{33} \end{bmatrix}. \quad (9)$$

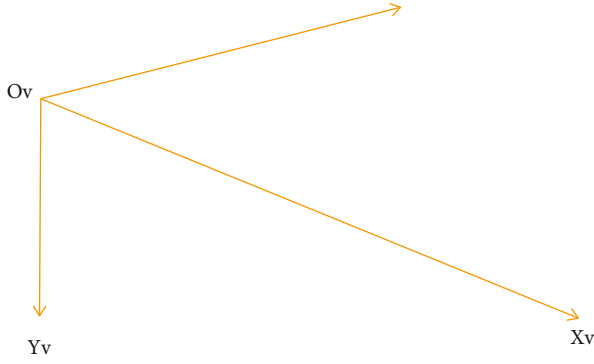


FIGURE 2: Relationship between three coordinate systems.

Formula (10) can be obtained by solving the formula.

$$A = \begin{bmatrix} \frac{1}{f_x^2} & 0 & \frac{-u}{f_x^2} \\ 0 & \frac{1}{f_x^2} & \frac{-v}{f_x^2} \\ \frac{-u}{f_x^2} & \frac{-v}{f_x^2} & \frac{u^2}{f_x^2} + \frac{v^2}{f_x^2} + 1 \end{bmatrix}. \quad (10)$$

Finally, the internal parameters of the camera are obtained, as shown in the formula below.

$$f_x = \sqrt{\frac{\lambda}{A_{11}}}, \quad (11)$$

$$f_y = \sqrt{\frac{\lambda}{A_{11}(A_{11}A_{22} - A_{12}^2)}}, \quad (12)$$

$$u = \frac{-A_{13}f_x^2}{\lambda}, \quad (13)$$

$$v = \frac{(A_{12}A_{13} - A_{11}A_{23})}{(A_{11}A_{22} - A_{12}^2)}, \quad (14)$$

$$\lambda = \frac{A_{33} - [A_{13}^2 + v(A_{12}A_{13} - A_{11}A_{23})]}{A_{11}}. \quad (15)$$

The parameters of the camera rotation matrix are expressed in vector form:

$$R = [r_1, r_2, r_3]. \quad (16)$$

According to the homography matrix  $H$  described in formula (5), the translation matrix  $T$  and rotation matrix  $R$  of the external parameters of the camera can be calculated, as shown in the formula:

$$r_1 = \lambda K^{-1}h_1, \quad (17)$$

$$r_2 = \lambda K^{-1}h_2, \quad (18)$$

$$r_3 = r_1 \times r_2, \quad (19)$$

$$T = \lambda K^{-1}h_3. \quad (20)$$

**3.2.3. Real-Time Filtering Processing of Depth Image.** In some cases, due to the strong reflected light on the surface of the irradiated object, the depth camera is overexposed, and the chip inside the camera cannot calculate the phase deviation, resulting in cavity noise [16, 17]. In order to remove the noise of hole and pixel jitter in depth image and ensure the quality of gesture image and real-time recognition efficiency, this study improves the traditional filtering algorithm and proposes a twice filtering algorithm to remove the noise in depth image. Image sensor CCD and CMOS introduce image acquisition due to the sensor material properties, working environment, electronic components, and circuit structure. After the weighted window filtering process, the division by zero mean filtering process is used. The distribution diagram of the original depth image and the pixel gray value processed by the twice filtering algorithm is shown in Figures 4(a) and 4(b). Figure 4(a) is the pixel gray value distribution diagram of the original image, and Figure 4(b) is the pixel gray value distribution diagram processed by the algorithm [4, 18].

Compared with the gray distribution map of the original image, the pixels near the zero value of the pixel distribution map after twice filtering are significantly reduced, which reduces the cavity noise of the image, and the peak value of the nonzero value pixels of the original image and the image after twice filtering is close to each other, maintaining the detailed characteristics of the image.

#### 4. Design of English Audio-Visual and Oral Mobile Teaching System Based on Virtual Augmented Reality Technology

In the teaching objectives of English, special emphasis is placed on audio-visual ability, and the teaching goal of English audio-visual is to cultivate students' practical language ability, so that students can effectively conduct English audio-visual communication in future work and communication, so that work or communication can be successfully completed to meet the needs of economic development and international exchanges, to be able to understand English lectures, daily English conversations, and lectures on general topics and basically understand slow English programs in English-speaking countries, with a speaking rate of about 130 words per minute and be able to grasp the main idea and grasp the main points, can use basic listening skills to aid comprehension, be able to communicate in English during the learning process and be able to discuss a topic, have the ability to converse with people from English-speaking countries on everyday topics, be able to make brief speeches on familiar topics after preparation, with relatively clear expression and basically correct pronunciation and intonation, and be able to use basic conversational strategies in conversation. The ancients said: "If you want to do well, you must first sharpen your tools." Augmented reality requires development platforms and tools as "sharp tools"

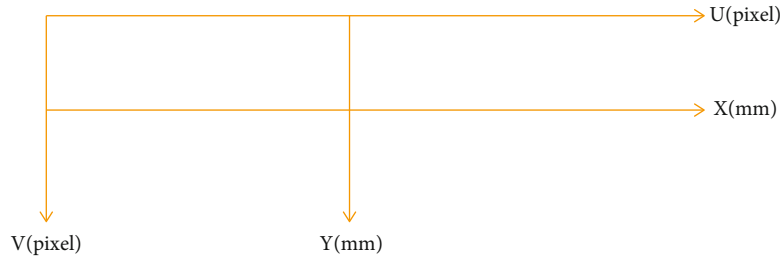


FIGURE 3: Pixel coordinate system and image coordinate system.

for research and development, so that software can be transformed from design blueprints into entities. In order to reduce the complexity and difficulty of augmented reality application development, many optimizations have been made for augmented reality development platforms, design platforms, and interactive platforms and have successively provided basic toolkits for designing and developing augmented reality, such as Unity 3D and Qualcomm SDK, Android SDK, 3D modeling software, and audio and video processing software. These tools include the most basic functions involved in augmented reality design and development, providing stable and convenient technical support for research and development. The core of augmented reality is to construct a “real” scene composed of virtual scenes on real objects and to achieve interaction.

#### 4.1. Introduction to Relevant Technologies

**4.1.1. Unity3D.** Unity3D is an augmented reality design engine developed by Unity Technologies with interactive graphics as the development environment. It provides the creation and rendering of scene models, supports the import of Vuforia SDK extension toolkit and tracking and detection under its corresponding interface, and realizes the AR application of virtual reality superposition and human-computer interaction. Unity3D can import 3D models in FBX obj format into the scene and environment and can add physical materials such as fog effect, wind, rain, ground, sky, sunlight and water, environmental sound effect, and video animation to the virtual scene. At the same time, it supports real-time browsing, testing, and editing of 3D application scenes [19, 20]. It is a cross platform development tool, which can release products directly to the required platforms, such as Android, IOS, and Windows.

**4.1.2. Vuforia SDK.** Vuforia augmented reality SDK is a software development kit launched by Qualcomm for augmented reality applications for mobile devices. It uses computer vision technology to identify and capture planar images or simple three-dimensional objects in real time, allowing developers to place virtual objects through the camera viewfinder and adjust the position of objects on the solid background in front of the lens [21, 22]. The data flow of Vuforia SDK includes four modules:

- (1) Input conversion module. The camera obtains the image of each frame of the current real scene and

converts it to the converted image format through the image converter

- (2) Database module. Refers to the form of data storage, including local device databases and cloud databases
- (3) Tracking detection module. It mainly realizes target tracking, which is composed of track Er, user defined targets, and word targets
- (4) Rendering input module. Including video background renderer and application code

These four modules are closely combined to transmit data and feedback problems to each other, which makes the Vuforia SDK play a good adaptation role in Unity3D. Combined with the powerful engine function of Unity3D, developers can develop excellent augmented reality interactive applications through simple design.

#### 4.2. Overall Design of VBook

**4.2.1. Design Objectives.** In “College English audio-visual speaking,” there will be three models (scene dialogue) in the speaking out part of each unit, each model corresponds to an illustration, and each illustration corresponds to a scene dialogue video [23]. The goal of vbook design is to scan the pictures in teaching materials through mobile devices, track them in real time, and match them with the identification pictures of cloud database. If the matching is successful, the video corresponding to the illustration will be seamlessly superimposed on the illustration of the teaching material, and the video playback, pause, full screen display, and other functions will be realized through the script code, so that users can experience augmented reality interaction and meet the characteristics of software ease of use.

**4.2.2. Design Idea.** Traditional augmented reality technology uses ARToolKit tool or 3D registration technology based on tracker and vision to realize marker recognition and virtual real superposition. The disadvantage is that the recognition degree is low and limited to the recognition of pure black or pure white two-dimensional images. The development of tools based on Unity3D and Vuforia SDK makes augmented reality technology have a broader application stage. Its markers adopt the method of feature point detection, which can recognize not only two-dimensional color images but also three-dimensional models, with strong real-time tracking effect. The illustrations of English audio-visual

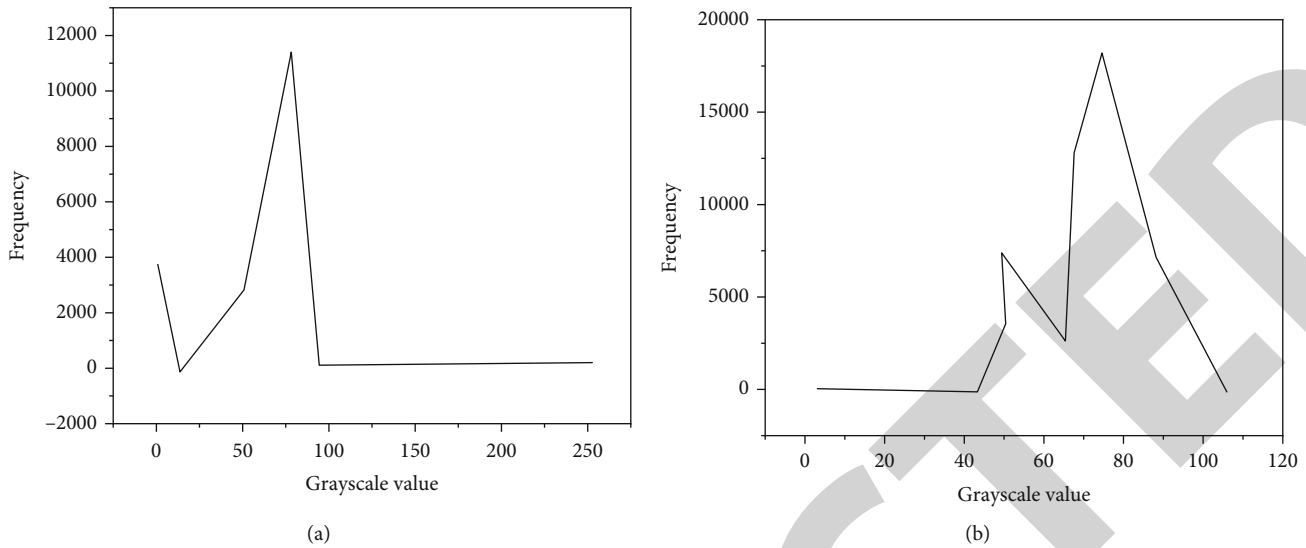


FIGURE 4: (a) Pixel gray value distribution: original image. (b) Distribution of pixel gray value: image after twice filtering.

and oral teaching materials are mainly color images, which are suitable for development with the Unity3D integrated Vuforia SDK toolkit, and the Unity3D engine can automatically generate terminal applications suitable for mobile devices, which is convenient for users.

**4.2.3. Technical Scheme.** The overall technical development route of the application is shown in Figure 5. Preliminary setting: including the whole application development process and the setting of docking points between software and hardware.

**3D construction:** from the perspective of role and model, it is divided into two parts. Maya is now the mainstream 3D animation software. The field of 3D visual art creation outside China is generally in Maya. Due to the huge Maya software system, comprehensive functions, and free combination of tools, Maya software can be applied to various 3D animation production processes. This time, Maya software is selected not only because of its convenience and strength but also because of its convenient connection between motionbuilder and motion capture software.

**Motion capture:** this part consists of two parts: limb motion capture and expression capture. Ipi studio and face-shift software and Microsoft Kinect somatosensory device are used to form two systems.

**VR/AR:** Unity3D is a game development tool developed by unity technologies. It is a professional game engine integrated across platforms. iPhone 8, MAC, WebGL, etc. can be released to Windows platform. This research also makes use of Unity3D's cross platform output and good creative interface. This part of Vuforia is an extension of Unity3D and serves as an important software toolkit for AR development (Vuforia augmented reality SDK). Upload the image that needs to be used as an identification image to Qualcomm's server, and then, turn the image into a black-and-white image; strengthen and extract image feature points; load feature points into package; Unity3D decompresses the package identification package and matches it in the program. When the program runs, it will continuously compare the feature point data package with the camera view

content and search the spatial position of the identification map in real time. It uses graphics recognition technology to detect and track images in real time, reverse the motion trajectory of the camera through the processor, and then, perfectly superimpose the developer's virtual object on the real scene picture to realize AR effect output.

**4.3. Detailed Design.** Detail design: the focus of this part is to break through the nonstandard part of some technical applications. It needs to make some special customization or significantly improve the efficiency through design skills.

- (1) Adjust Kinect dual position to record action information, and select the two opposite directions to obtain the best acquisition effect
- (2) Change the proofreading apparatus to make the motion capture data more accurate. Replace the square proofreading board in IPI studio with a cross wooden frame, which improves the alignment efficiency of the two Kinect devices in the proofreading process and quickly generates the camera position relationship file
- (3) Use the identification mechanism of Vuforia extension to make an appropriate identification diagram to improve the identification efficiency
  - (i) The color block with similar lightness should be avoided in the recognition map; otherwise, when it becomes a black-and-white map, only the lightness relationship is left, and the shape characteristics of the picture are not obvious. For seemingly complex pictures, it is difficult to generate recognition points because of the similar lightness. The Hough transformation is a way to connect the edge pixels by using the global characteristics of the images. The basic idea is the duality of the point-line



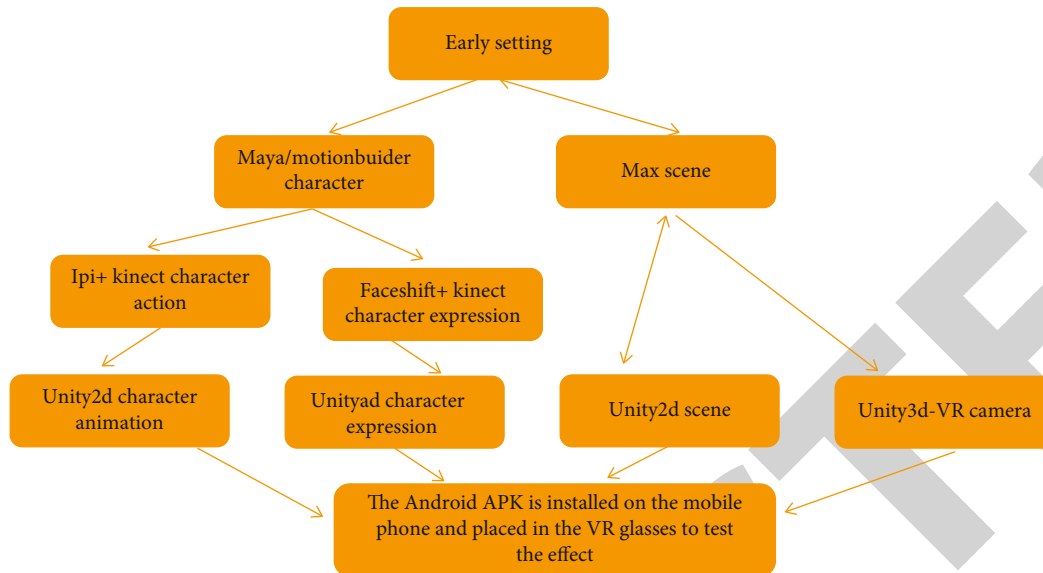


FIGURE 5: Application development technical scheme.

- (ii) The dividing line between color blocks is an important indicator of recognition efficiency. The design of color colliding picture can still keep a clear dividing line in the recognition picture after gray processing. These boundaries of strong contrast between color and lightness are an important position for program automatic recognition of information in computer graphics and imaging
- (iii) The uneven distribution of recognition information on the way may also lead to very low recognition rate. For example, the image boundaries appear at one end or in a small range of the recognition map
- (iv) If the three-dimensional object to be displayed by fusion is not placed in the middle of the recognition map, the error of limit optical and computing power will be maximized. Therefore, the virtual object needs to be in the central area of the recognition map as far as possible; compared with electronic computing, it has the advantages of high speed, high broadband, and low power consumption. Otherwise, the imaging result will have imperfect vibration

#### 4.4. System Functions

**4.4.1. Functional Structure.** The overall goal of web-based virtual teaching system is to provide students with a good online learning platform by providing online video, online browsing teaching courseware, online real-time interaction between teachers and students, online experiment, and downloading all kinds of teaching resources. The overall function of the virtual teaching system is shown in Figure 6.

The web-based virtual teaching system mainly includes two parts: virtual course platform and online experiment subsystem. The virtual course platform mainly includes personnel management, virtual classroom, online video play-

back, online message, in station email, electronic whiteboard, and teaching resource display functions. The goal of the virtual course platform is to provide students with a good online learning platform. The online experiment subsystem mainly includes online experiment, experiment management, and virtual teaching scene module.

**4.4.2. Use Case Analysis.** This paper abstractly analyzes the system from the perspective of entity objects and object behavior involved in web-based virtual teaching system and obtains the use case diagram of web-based virtual teaching system, as shown in Figure 7.

Virtual teaching system includes three types of users: administrators, teachers, and students. Administrator users are automatically established after system initialization, and teachers and student users need to be established through system registration. The user registration case description is shown in Table 2.

After the teacher users register and improve their personal information through the user registration module, the administrator needs to review the teacher information before entering the teacher platform of the virtual teaching system. The use case description of teacher audit is shown in Table 3.

When teachers need to open an online course, they can apply for an open course through the application course module. The use case description of teachers applying for courses is shown in Table 4.

After the teacher's application for the course is completed, the course becomes to be approved. The teacher can open the corresponding course only after it is approved by the administrator. The use case description of the audit course is shown in Table 5.

After entering the online experiment module, students can program the experimental items provided by teachers online, save the experimental status, and download the experimental items. The online experiment case description is shown in Table 6.

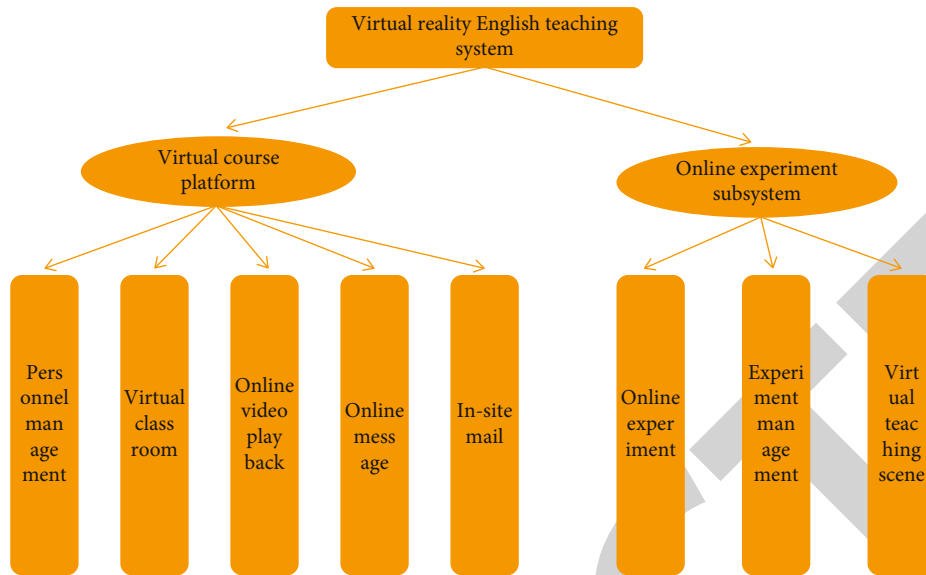


FIGURE 6: Overall functional structure of the system.

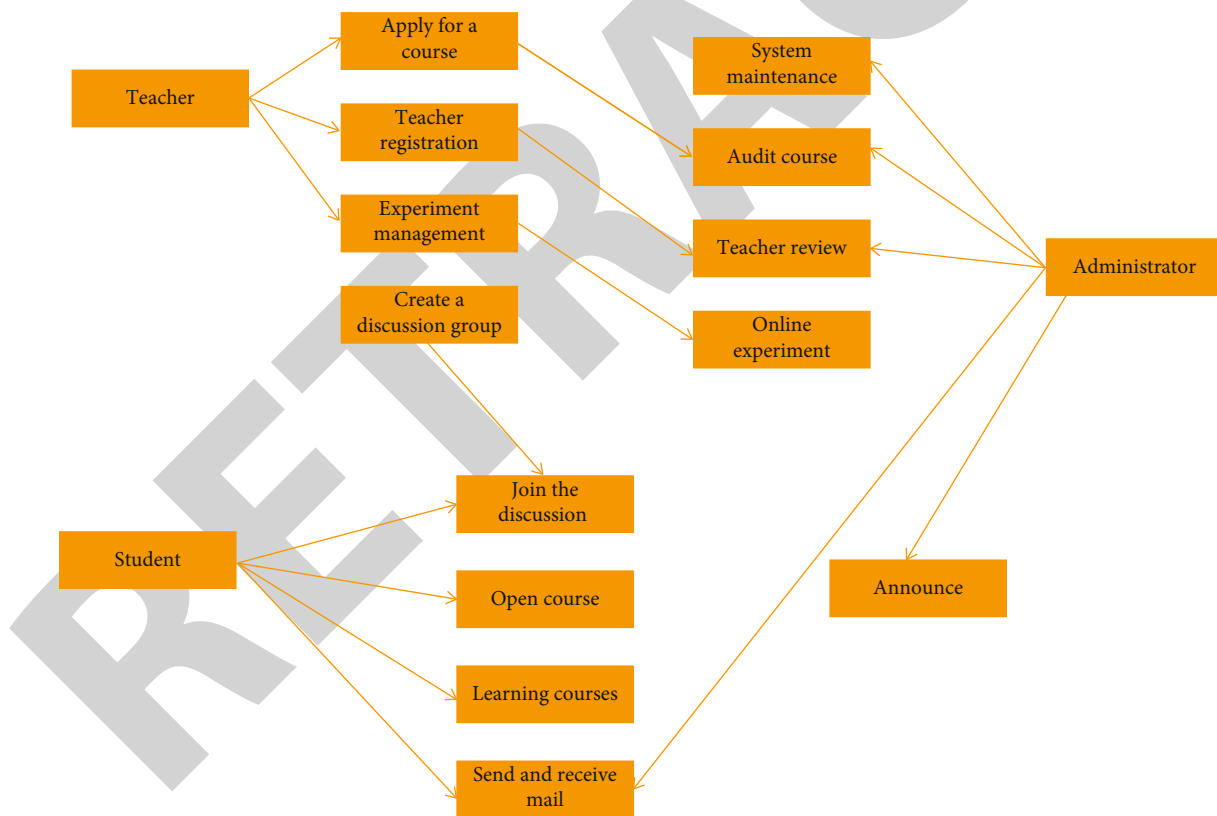


FIGURE 7: Use case diagram of web virtual teaching system.

According to the design objectives and requirements, based on the design principles of simplicity, efficiency, and convenience for users, the design of VBook is divided into three core modules.

- (1) Image preprocessing and storage. Cut the captured textbook illustrations to the same size and name

them according to certain rules, preprocess them with Vuforia SDK tool, process the pictures into recognizable pictures, and save them to the cloud

- (2) Video preprocessing and storage. Obtain the video data from the CD, name it according to the corresponding picture name, and then, save it to the local server

TABLE 2: User registration case description.

Use case name	User registration
Range	User registration module usage
Level	User purpose
Major participants	Students and teachers
Relevant personnel and concerns	Focus Teachers want users to enter the registration information correctly Students want users to enter their registration information correctly
Preconditions	Log in to the user registration system correctly

TABLE 3: Description of teacher audit cases.

Use case name	Administrator audit teacher
Range	Application of teacher audit module
Level	User purpose
Major participants	Administrators
Relevant personnel and concerns	Focus Hope can get the login permission correctly. It is hoped that the relevant data of all approved teachers will be correctly stored in the database
Preconditions	The user has registered a user as a teacher, and the teacher is waiting for approval

TABLE 4: Use case description of teachers applying for courses.

Use case name	Teachers apply for courses
Range	Use of teacher application course module
Level	User purpose
Major participants	Teacher
Relevant personnel and concerns	Concerns of relevant personnel Teachers hope to correctly submit their applied courses and apply for open courses
Preconditions	Teachers can log in to the system correctly and legally
Guarantee of success	All correct data can be saved in the database.

TABLE 5: Use case description of audit course.

Use case name	Audit course
Range	Use of course review module
Level	User purpose
Major participants	Administrators
Relevant personnel and concerns	Concerns of relevant personnel The administrator wants all the data stored in the database to pass the audit correctly
Preconditions	The teacher has passed the identity authentication and applied for the course. The course is waiting for approval
Guarantee of success	Teachers can correctly apply for corresponding courses, the approved courses can be viewed by students, and teachers cannot modify the approved courses. All correct data can be saved in the database.

(3) Data matching and processing. Including AR design and user use. Among them, the rectangular box part of the dotted line is AR design, and the data matching of the user's use process is outside the dotted line box: the user scans the illustration, matches the identification diagram saved in the cloud, uses the script

code to access and obtain the corresponding video, and displays the video to the user

The system design is based on Unity3D development tool and Vuforia SDK augmented reality software development kit. Designed with the MVC framework of Unity3D,

TABLE 6: Online experiment case description.

Use case name	Online experiment
Range	Use of online experiment module
Level	User purpose
Major participants	Student
Relevant personnel and concerns	Concerns of relevant personnel Students hope to experiment through the online experiment function
Preconditions	Students pass identity authentication and enter the online experiment function
Guarantee of success	Teachers have successfully opened online experiments and set experimental data

model M includes access to components, data files, renderers, cameras, and other objects; view v presents the model and manages the engine rendering of Unity3D; controller C receives user input and invokes the event method of the model object. It mainly realizes data matching and AR scene design.

(1) Identification map creation and feature point recognition

(i) Identification diagram creation. Select the illustrations in the textbook for shooting, cut the pictures and name them regularly, use Vuforia SDK to process and generate the identification map, build the identification map database and save it to the cloud, and generate two secret keys for accessing cloud data: access key and secret key. When the user uses the camera scan of the mobile device, he accesses the cloud database through the secret key

(ii) Feature point recognition. The recognition image generated after the processing of the original image is a gray image, which is matched by feature points. Vuforia provides the star rating standard of matching degree. The more the number of stars, the higher the success rate of scanning matching and the shorter the scanning recognition time. Therefore, when preprocessing the image, try to make the image star reach a higher star level as much as possible

(2) Unity3D scene construction

Download Vuforia SDK toolkit vuforia-unity.unitypack and integrate it into Unity3D. Create a new Unity3D project scene and add arcamera, ImageTarget, and video objects of Vuforia SDK to the scene, respectively. The bottom ImageTarget object is the recognition map carrier, which is used to match the picture obtained by arcamera with the recognition map. When the matching is successful, the upper video object will be displayed. The video object is the video carrier and displayed in the form of customized virtual play button picture. The video playback can be controlled through the button.

In the actual design, the video object is overlaid on the ImageTarget object as a subobject of ImageTarget, so that the video can be displayed with illustrations all the time.

(3) Video preprocessing and storage

Copy out all the scene dialogue videos in the CD-ROM given by the textbook and name them according to the corresponding illustration name, and then, upload the named video files to the locally accessible server to ensure that any mobile terminal can access these video materials, but the visiting user cannot change the video materials to ensure the integrity and consistency of the data.

(4) Script for video playback

The function of video object controlling video playback is realized by writing script code. The Vuforia SDK provides the TargetFinder class to judge whether the pictures obtained by arcamera match the database data of identification pictures. The picture information after successful matching is saved to Target-Finder. TargetSearchResult.

First, get the video path according to the picture name:

Video. m\_path = "Video storage server URL directory path" +target SearchResult. Target Name + ". 3g2"; the core code of the script to realize video loading, playback, pause, and full screen functions is as follows:

(i) Video loading and playback

Video. Video Player. Load (video. m \_ path, video. MediaType, false, 0); video. Video Player. Play(true, 0);

(ii) Video pause

If (video. Current State == Video Player Helper. MediaState.PLAYING){video. Video Player. Pause(); }

(iii) Video full screen

Play Fullscreen Video At End Of Frame (Video Playback Behaviourvideo)

(5) Implementation and release of mobile applications

Unity3D can directly publish applications to different platforms. Here, select Android platform to generate VBook.apk installation package file, and send this installation

package file to Android mobile phone to install and run directly.

## 5. Conclusion

The English audio-visual and oral mobile teaching system can realize the connection between the real classroom and the online classroom, expand the complete large-scale learning mode to the fragmented learning mode, stimulate students' enthusiasm for audio-visual learning, and greatly improve the learning efficiency. The mobile teaching mode of English audio-visual can significantly improve the teaching of English audio-visual. Augmented reality technology, as an extension of virtual reality technology, has brought unprecedented visual experience to people, making people sigh the infinite charm of modern technology. As a fast-developing new form of software, it is constantly infiltrating into the field of learning, gradually promoting the development of the field of learning and research. Experience and restore the reality of knowledge by building a ubiquitous learning space that seamlessly integrates virtual space and physical space and further meets the needs of knowledge seekers for interactivity, immediacy, and personalization. This article relies on Unity3D's powerful rendering engine and visual operation interface, coupled with Vuforia toolkit and its powerful augmented reality effect; developers can get started in a very short time. VBook mainly uses augmented reality technology to vividly present the learning video in front of users, so that users can feel the interactive experience different from traditional learning methods, that is, it solves the problem of students' difficulty in obtaining textbook video and also stimulates students' interest in learning. Of course, the application of augmented reality is not only that but also a considerable number of places need to be used. In the future, we will further study augmented reality technology, and augmented reality will be popularized in China.

## Data Availability

The data used to support the findings of this study are available from the corresponding author upon request.

## Conflicts of Interest

The authors declare that there are no conflicts of interest regarding the publication of this paper.

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