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Curriculum for augmented and virtual reality competition

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Contents

Foreword

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Curriculum for augmented and virtual reality competition

1 Scope

This document specifies the basic requirements, safety regulations, assessment proportion, competition performance evaluation and award setting for the contest of enhancement and virtual reality, including but not limited to the resource requirements for personnel, site and equipment for the contest of enhancement and virtual reality.

This document is applicable to the holding and organization of augmented and virtual reality competitions.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
skilled talents
individuals who possess specialized knowledge and skills, have corresponding practical (internship) work experience, and are able to independently (or collaboratively)   complete practical work tasks in production, service, and management frontline work

3.2
vocational ability
ability to solve comprehensive professional problems as a whole in real work situations is a necessary skill for people to engage in one or several similar professions, and is a combination of general and professional abilities

3.3
general ability
social and methodological abilities required for engaging in the corresponding profession include professional ethics, communication with others, cooperation with others, self-learning, problem-solving, information processing, digital application, foreign language application, innovation ability, management ability, etc

3.4
professional competence
ability of people to apply knowledge and skills to solve practical problems in a specific profession, including the grasp of work standards, the application of work methods, the use of labor tools, and the selection of labor materials

3.5
typical work tasks
comprehensive tasks with complete work processes and elements determined through expert interviews are of typical significance for engaging in a profession (job group)   and serve as the basis for curriculum development in vocational colleges

3.6
representative work tasks
specific tasks of challenging positions that practical experts engage in during their career growth process, which can promote the development of their professional abilities

3.7
virtual reality
digital artificial environment that integrates multiple senses such as vision, hearing, touch, smell, and taste is generated using modern high-tech methods with computers as the core. Users use some input and output devices to interact and influence objects in the virtual world in a natural way, thus creating a feeling and experience of being in the real environment

3.8
augmented reality
a technology that cleverly integrates virtual information with the real world, widely using various technological means such as multimedia, 3D modeling, real-time tracking and registration, intelligent interaction, sensing, etc. After simulating computer-generated virtual information such as text, images, 3D models, music, videos, etc., it is applied to the real world. The two types of information complement each other, thus achieving "enhancement" of the real world

3.9
immersive virtual reality
a fully immersive experience that provides participants with a feeling of being in a virtual world. Its characteristic is to use a helmet mounted display to enclose the user's visual and auditory senses, generating virtual vision. At the same time, it uses data gloves to enclose the user's tactile channel, generating virtual tactile sensation. The system uses a speech recognizer to allow participants to issue operational commands to the system host. At the same time, the head, hands, and eyes are all tracked by corresponding head trackers, hand trackers, and eye gaze trackers, enabling the system to achieve real-time performance as much as possible

3.10
virtual model construction
utilizing virtual reality technology, real-world objects are simulated in a virtual digital space. Virtual reality technology integrates multiple disciplines such as digital image processing, computer graphics, multimedia technology, sensing and measurement technology, simulation, and artificial intelligence, creating a realistic, virtual, and interactive 3D spatial environment for people

3.11
render
refers to the process of generating images from a model using software. Rendering is the final process in CG, and it is also the stage of making the image conform to the 3D scene, transforming models, scenes, etc. in 3D software into animations or image formats for output

3.12
UI interface
medium for interaction and information exchange between the system and users, which enables the conversion between the internal form of information and a form that is acceptable to humans

3.13
material
can be seen as a combination of material and texture. In rendering programs, material is a combination of various visual properties of the surface, including color, texture, smoothness, transparency, reflectivity, refractive index, luminosity, etc. These properties endow 3D models with material properties

4 Curriculum overview

4.1 Typical work task description

There are three core fields in the virtual augmented reality development contest: virtual model construction and rendering, UI interface design and production, and virtual augmented reality application program development.
The typical job tasks for virtual model construction and rendering are described in table 1.

Table 1　Typical task description of virtual model construction and rendering

Typical work task name	Virtual model construction and rendering
Typical work task description	

The construction and rendering of virtual model of typical task description is the basis of realizing reality, interactivity and immersion in virtual software development. Through high-quality modeling and real-time rendering technology, developers can create an attractive virtual environment, enabling users to get immersive experience in the virtual world. This process includes model construction, application of materials and textures, lighting settings, camera adjustments, and final rendering.

The main application hardware of this work is a high-performance computer, the recommended CPU is a multi-core processor, GPU is a high-performance graphics card, the RAM is at least 16GB and the solid-state storage disk is applied. Commonly used software includes AutoCAD 3Ds Max, AutoCAD Maya, Brener, Cinema 4D, Adobe Photoshop, V-Ray, etc.

For the development of virtual reality software, the project manager is required to prepare the model demand list according to the customer's needs. The demand list needs to specify the model quantity, quality requirements, time nodes and other contents required by the project. The modeling and rendering engineer needs to complete the relevant work tasks according to the demand list, and finally deliver to the project manager for acceptance.

1	Object of work	Obtain task	Requisition of project demand list Communicate with the Project Manager Communicate with customers
		Making plan	Determine work objectives Content of analysis Develop work steps Assignment of working hours Prepare work plan Submit to the business department for review and confirmation
		Construction of virtual model	Demand analysis and research Model construction Model optimization Material Mapping
		Model mapping rendering	Scenario layout Light source setting Optimization of rendering
		Quality self-inspection	Shape of model Material mapping Model Capacity Model effect
		Delivery acceptance	Check the demand list Effect acceptance Delivery by signature

Table 1 *(continued)*

		Typical work task name	Virtual model construction and rendering	
		Typical work task description		
2	Tools, materials, equipment and data	Obtain task links	Project demand list, software planning scheme, customer contact information, design standard	
		Planning links	Project demand list, software planning scheme, design standard and project schedule	
		Virtual model construction	Project demand list, software planning scheme, design standard and project schedule	
		Model map rendering	Project requirement list, software planning scheme, design standard and project schedule	
		Quality self-inspection	Design standard, project schedule and self-inspection table	
		Delivery acceptance:	Assignment book and acceptance sheet	
3	Working method	Obtain task link	information retrieval	
		Planning link	SMART principle	
		Virtual model construction	Polygon modeling, photogrammetric modeling, scanning modeling and surface modeling.	
		Model mapping rendering	Effect comparison method	
		Quality self-inspection link	Observation method, program test method	
		Quality self-inspection	-	
		Delivery and acceptance	-	
4	Work requirements	Obtain the task link	Obtain the project demand list and customer contact information from the project manager, use the retrieval method to obtain the software planning scheme, communicate with the business department and the customer, and understand the working conditions and objectives.	
		Formulation of plan links	According to the communication with the business department in the project demand list, define the work objectives of the task, analyze the work contents and formulate the work steps, allocate the work time according to the requirements of the task book, complete the work plan, and submit it to the business department for review and confirmation.	
		Virtual model construction	Accurate modeling by 3D modeling software according to the project demand list and design standards through understanding the customer requirements and software development platform characteristics, including creating geometry, adjusting size, applying texture, etc. After the completion of the basic model, the details of the model are further refined, such as adding material and texture, adjusting model scale and posture, etc.	
		Model Map Rendering	After the virtual model is constructed, add material, texture and color to the 3D model, and bake the normal and CV and AO maps after UV segmentation. It is not only to restore the original picture from the color, but also to make the texture of each material, making the model more realistic. Set appropriate	

Table 1 *(continued)*

Typical work task name		Virtual model construction and rendering
Typical work task description		
5	Labor organization mode	For this task, the number of staff is arranged according to the size and time of the task. The modeling and rendering engineer is required to obtain the demand book from the project manager, and provide the user with acceptance and Q&A services if necessary.
Representative work task		
Task name	Task description	Learning hours
Construction of 3D model	A unit receives a virtual reality software development business, and the project manager divides and arranges the virtual simulation task, and requires the 3D modeling engineer to complete the model construction work with quality, quantity and time according to the project demand list, so as to facilitate the mapping and rendering work in the next link.g. Modeling engineers usually need two people. They obtain the project requirements form from the project manager and first need to clarify the modeling goals and requirements, including understanding the purpose, functionality, appearance features, and application platform of the modeling object. Modeling engineers create basic geometric models through 3D modeling software using various graphic commands, such as rectangles, cylinders, spheres, etc. Then, based on the basic geometric model, the advanced modeling command is used for trimming to adjust the detail, scale and size of the model. Then add details and attachments to the modeling object to improve the reality and detail performance of the model. Optimize the model by deleting redundant edges, faces and vertices, or merging multiple vertices into one vertex with the collapse function, so as to improve the rendering speed and reduce the memory occupation and ensure the smooth operation of the software. Finally, it shall be delivered to the rendering engineer for further work.	24
3D model rendering	When a unit receives a virtual reality software development business, the project manager divides and arranges the virtual simulation task, and requires the 3D rendering engineer to realize high-quality texture rendering of the 3D model after the modeling process is completed, so that the virtual environment has a realistic effect and facilitates the application of the follow-up program development link. The 3D model rendering engineer usually requires two people. They obtain the project requirements form from the project manager and first need to clarify the rendering goals and requirements, including understanding the purpose, function, appearance features, and application platform of the rendered object. When the rendering engineer receives the model file in the previous link, first create a 3D scene containing the model file, arrange the environment and set camera parameters in the scene. Next,	24

The typical job tasks for UI interface design and production are described in table 2.

Table 2　Typical job task description for UI interface design and production

Typical work task name	UI interface design and production		
Typical job task description			
The typical tasks of UI interface design and production for virtual reality software cover the entire process from requirement analysis to functional implementation. It is the foundation for achieving user friendliness, interactivity, and immersion. Through precise interface layout and interaction design, developers can create intuitive and efficient user interfaces that enable users to easily navigate and operate virtual environments. This process includes the design of interface layout, implementation of interactive elements, integration of user feedback, and development of functions. Firstly, the designer understands user needs and functional requirements through in-depth discussions with the project team and clients, and designs detailed visual effects such as icons, buttons, and interface layouts. Simultaneously consider various functional requirements that support virtual simulation, such as gesture control, voice commands, and spatial navigation, to ensure that all design elements meet the actual needs of users. Ultimately, designers write detailed design documents and user guides for continuous maintenance and updates in response to user feedback, technological advancements, and changes in virtual simulation software functionality. The main application hardware for this job is high-performance computers, with a recommended CPU of multi-core processors, GPU of high-performance graphics cards, RAM of at least 16GB, and solid-state storage hard drives. Common software includes Adobe Photoshop, Unity, Unreal Engine, Veryengine, etc. The design and production of the UI interface for virtual reality software require the completion of corresponding work based on customer needs and software planning documents, while fully considering user habits and the convenience of interactive experience. After completing the relevant work tasks, engineers will complete self inspection and optimization, and finally deliver to the project manager for acceptance.			
1	Object of work	Obtain tasks	Collect project requirement form Communicate with the project manager Communicate with clients
		Develop a plan	Determine work objectives Analyze job responsibilities Develop work steps Allocate work time Prepare a work plan Submit to the business department for review and confirmation
		UI design	Customer requirement analysis Software architecture design Software interface design
		UI element production	Button element production Menu element production Information panel production
		UI Function Development	Create UI Components UI interaction function development Adaptation function development
		Quality self inspection	UI style UI element quality UI functionality

Table 2 *(continued)*

	Typical work task name		UI interface design and production	
			Typical job task description	
1	Object of work	Delivery acceptance	Verify the demand sheet Effect acceptance Sign and deliver	
2	Tools, materials, equipment, and materials	Task acquisition process	Project requirement sheet, software planning scheme, customer contact information, design standards	
		Planning process	Project requirement list, software planning scheme, design standards, project schedule	
		UI design	Project requirement sheet, software planning scheme, design standards, project schedule	
		UI element production	Software planning scheme, design standards, UI design scheme, project schedule	
		UI function development	Software planning scheme, design standards, UI design scheme, project schedule	
		Quality self inspection	Design standards, project schedule, self inspection form	
		Delivery acceptance	Task book, acceptance form	
3	Work requirements	Obtain the task link	Obtain the project demand list and customer contact information from the project manager, use the retrieval method to obtain the software planning scheme, communicate with the business department and the customer, and understand the working conditions and objectives.	
		Formulation of plan links	According to the communication with the business department in the project demand list, define the work objectives of the task, analyze the work contents and formulate the work steps, allocate the work time according to the requirements of the task book, complete the work plan, and submit it to the business department for review and confirmation.	
		UI design	According to the software planning scheme and the design standards, the functions and interaction modes of the UI interface are designed to ensure that the UI interface of VR software is both beautiful and fully functional and can provide good user experience.	
		UI element production	According to the UI design scheme, make buttons, menus, information panels and other UI elements. During the production process, pay attention to the color effect, text font, layout effect, multi-state appearance and other contents of the UI elements.	
		UI function development	According to the UI design scheme, develop UI related functions, including creating UI components, UI interaction functions and UI adaptation functions. It is required to consider the loading time and response speed, and finally convert the UI design into a fully functional application interface to ensure smooth and efficient user experience.	
		Quality self-inspection link	Use observation method and program test method to check whether the effect and function of UI elements meet the target requirements.	

Table 2 *(continued)*

Typical work task name			UI interface design and production	
Typical job task description				
3	Work requirements	Delivery acceptance link	Inspected and accepted by the third party according to the acceptance form.	
4	Working method	Task acquisition stage	Information retrieval	
		Planning process	SMART principle	
		UI design	Global perspective, minimization principle, user path diagram	
		UI element production	Effect comparison method	
		UI function development	Friendly interaction principle, operability, maintainability	
		Quality self inspection	-	
		Delivery acceptance stage	-	
5	Labor organization method		This task requires the UI design and production engineer to obtain the requirement document from the project manager and provide acceptance and Q&A services to users if necessary, based on the size of the task and the number of staff arranged according to the time.	
Representative work task				
Task name		Task description		Learning hours
UI design		When a unit receives a virtual reality software development task, the project manager makes detailed division and arrangement for the virtual simulation task. He asked the UI engineer to communicate with the customer, confirm the project requirements, and complete the interactive design and production of the software, so as to facilitate the application in the subsequent program development phase. UI engineers need to understand the needs, behaviors and habits of the target users in depth, analyze the application scenarios, and determine the functions and interaction modes of the UI interface based on this to ensure that the UI interface of VR software is both beautiful and functional, and can provide good user experience. The main work contents of UI design are as follows: Customer demand analysis: Understand the demands, behaviors and habits of the target users, analyze the application scenarios, and determine the functions and interaction modes of the UI interface. Software architecture design: formulate software content architecture, design user navigation and interaction path in VR environment, and ensure user can find required information intuitively. Software interface design: design UI elements in VR environment, such as buttons, menus, information panels, etc., design 3D UI elements suitable for VR environment, consider depth, space sense and user perspective, determine color, font, icons and other visual elements, and ensure that UI elements are clearly visible in VR environment. Finally, the results of UI design will be documented and delivered to the process engineer for the next step of work.		12

Table 2 (*continued*)

Typical work task name	UI interface design and production	
Task name	Task description	Learning hours
UI element fabrication	When a unit receives a virtual reality software development task, the project manager makes detailed division and arrangement for the virtual simulation task. He requires to immediately enter the production of UI elements after the completion of UI design. The final effect shall be confirmed by the customer and delivered to the UI function development group for application after completion. Based on the UI design document, firstly draw a sketch to plan the basic layout and structure of the UI elements, select the appropriate design style, then set the size and basic shape of the elements according to the design specifications, and then add the details of the UI elements, such as buttons, menus, edge color effects of information panels, text fonts, layout effects, multi-state appearance, etc. Then, optimize the details to ensure alignment, spacing, and color contrast, and create a high-fidelity prototype for user testing. Finally, design specifications and resources are delivered to the development team and subsequent testing and iterations are conducted to optimize the user experience.	12
UI function development	When a unit receives a virtual reality software development task, the project manager makes detailed division and arrangement for the virtual simulation task. He requires that after the completion of UI elements, immediately enter the development of UI functions, and after the completion, the program development engineer shall be delivered for system integration. Based on the UI design document, first add UI elements in the virtual environment to ensure that the UI can fit properly on different screen sizes and devices. Create reusable UI components and add interactive functions for UI components, correctly obtain and submit data, and handle data display and interaction. When the overall function is realized, the loading time and response speed shall be optimized, and the details of UI elements shall be adjusted to improve the user experience. Finally, the UI design is transformed into a fully functional application interface to ensure the smoothness and efficiency of the user experience and deliver it to the program engineer for the next step of work.	12

The typical job tasks for virtual reality application development are described in table 3.

Table 3 Typical task descriptions for virtual reality application development

Typical work task name	Virtual reality application development
Typical work task description	

Virtual reality application development is the process that endows the virtual reality world with the soul. Make the object in the virtual world have the state and interaction function of the real world. Through real-time feedback and interaction, the user can operate the object, control the role, and interact with the virtual world, so as to experience the authenticity of the virtual environment more profoundly, as if he is really in it. Thus the virtual world becomes vivid and has a "soul".

The main application hardware of this work is a high-performance computer, the recommended CPU is a multi-core processor, GPU is a high-performance graphics card, the RAM is at least 16GB and the solid-state storage disk is applied. The main application development platforms include Unity, Unreal Engine, Veri, etc

In the virtual reality application program development link, the engineer realizes the virtual world environment change, physical simulation, space sound effect, interactive communication and other mechanisms through the development of role control function, information display function, object movement function, parameter setting and other functions, so that the user can get the

Table 3 *(continued)*

Typical work task name		Virtual reality application development	
Typical work task description			
immersive experience in the virtual world. For the development of virtual reality application program, the corresponding function development shall be completed according to the customer requirements and the software plan. The development effect shall be close to the real world situation, the operation shall be simple and convenient, and the interaction process shall be friendly. The engineer shall complete self-inspection and optimization after completing relevant work tasks, and finally deliver to the project manager for acceptance.			
1	Object of work	Obtain task	Requisition of project demand list Communicate with the Project Manager Communicate with customers
		Making plan	Determine work objectives Content of analysis Develop work steps Assignment of working hours Prepare work plan
		Making plan	Submit to the business department for review and confirmation
		Role control function development	Role mobile function development Development of virtual interactive operation function Pickup drag operation function development Voice interaction function development Gesture interactive function development Controller interactive function development Development of somatosensory interaction function
		Information display function development	Development of explosion observation function Development of outgoing line identification function Transparent observation function development Development of observation function of picture in picture
		Object motion function development	Regular motion function development Development of composite motion functions Parametric motion function development
		Development of parameter setting function	Home Page Return to Function Development Best Viewpoint Function Development Development of view speed function Function Introduction Function Development Particle special effect setup development
		Quality self-inspection	Functional Integrity Smoothness of operation Interactive friendliness Correctness of contents

Table 3 (*continued*)

	Typical work task name		Virtual reality application development
	Typical work task description		
1	Object of work	Delivery acceptance	Check the demand list Effect acceptance Delivery by signature
2	Tools, materials, equipment and data	Obtain task links	Project demand list, software planning scheme, customer contact information, design standard
		Planning links: project	Demand list, software planning scheme, design standard and project schedule
		Role control function development	Project demand list, software planning scheme, design standard, project schedule, function self-inspection table
		Information display function development	Project demand list, software planning scheme, design standard, project schedule, function self-inspection table
		Object motion function	Development: project demand list, software planning scheme, design standard, project schedule, function self-inspection table
		Parameter setting function development	Project demand list, software planning scheme, design standard, project schedule, function self-inspection table
		Quality self-inspection	Design standard, project schedule and self-inspection table
		Delivery acceptance	Assignment book and acceptance sheet
3	Working method	Obtain task link	Information retrieval
		Planning link	SMART principle
		Role control function development	-
		Information display function development	-
		Object motion function development	-
		Parameter setting function development	-
		Quality self-inspection	Design standard, project schedule and self-inspection table
		Delivery acceptance	Assignment book and acceptance sheet
4	Work requirements	Obtain the task link	Obtain the project demand list and customer contact information from the project manager, use the retrieval method to obtain the software planning scheme, communicate with the business department and the customer, and understand the working conditions and objectives.
		Formulation of plan links	According to the communication with the business department in the project demand list, define the work objectives of the task, analyze the work contents and formulate the work steps, allocate the work time according to the requirements of the task book, complete the work plan, and submit it to the business department

Table 3 (*continued*)

Typical work task name			Virtual reality application development	
Typical work task description				
4	Work requirements		for review and confirmation.	
		Role control function development	By understanding customer needs and software function planning, plan the role control function development plan, and develop corresponding functions according to the characteristics of the hardware platform. Pay attention to the convenience and friendliness of interactive experience during development.	
		Development of information display function	First understand the user's needs and focus, and plan the virtual display mode according to the display contents (graphic information introduction, product structure recognition, working principle, appearance and shape expression, etc.). It is required to have good user experience such as clear information expression, novel interaction mode, simple and convenient operation, etc.	
		Object motion function development	Master the development contents according to the software planning scheme and relevant materials, and select reasonable motion functions to realize the digital twin of the product. And the motion parameters are optimized to finally realize the virtual effect close to the real state.	
		Parameter setting function development	According to the software planning scheme, set the function buttons to facilitate user operation and use.	
		Quality self-inspection link	Use observation method and program test method to check whether the operation effect of virtual simulation program meets the target requirements.	
		Delivery acceptance link	Inspected and accepted by a third party according to the acceptance form.	
5	Labor organization mode		For this task, the number of staff shall be arranged according to the size and time of the task. The engineer is required to obtain the demand from the project manager, and provide the user with acceptance and Q&A services if necessary.	
Representative work task				
Task name	Task description			Learning hours
Role control function development	A unit receives a virtual reality software development business, and the project manager divides and arranges the virtual simulation task. The functional development team is required to carry out the functional development of the virtual simulation program after the modeling and rendering process is completed, and the engineer A is responsible for operating the control function development module. Engineer A obtains the project requirement form from the project manager. First, he/she shall understand the application application, function, interactive experience and hardware, analyze and plan the role control function scheme. Basic control functions to be developed by Engineer A: Role movement operation: the user can move freely in the virtual environment and navigate by means of blinking or walking.			12

Table 3 *(continued)*

Typical work task name	Virtual reality application development	
Representative work task		
Task name	Task description	Learning hours
	Virtual interactive operation: the user can interact with the virtual environment through the operation in 3D space, such as moving, rotating and zooming objects.	
Role control function development	Pickup and drag operation: users can pick up virtual objects and drag to move and place objects. Specific functions are developed with hardware devices (PC, helmet, cell phone, etc.) defined: Voice interaction: users can interact with the virtual environment through voice commands to realize voice control and voice feedback. Leap motion: Gesture recognition technology allows users to perform various operations such as grab, drag and rotate objects through the actions of hands or fingers. This type of interaction is especially important in immersive virtual reality games. Controller Interaction: VR HMDs are typically equipped with handles or controllers that allow users to operate accurately. Body feeling interaction: capture the action data of the user through the body feeling device, realize the natural and smooth action response, and provide a new interactive experience for VR games. Upon completion of the above functions, the program engineer shall be handed over for commissioning and optimization.	12
	A unit receives a virtual reality software development business, and the project manager divides and arranges the virtual simulation task. The functional development team is required to carry out the functional development of the virtual simulation program after the modeling and rendering process is completed. Engineer B is responsible for the information display function development module.	12
Information display function development	Engineer B obtains the project demand form from the project manager. After communication, the customer needs to use a variety of methods to display the product information and internal structure. It is required that the user experience cannot be single, the information expression is clear, and the interaction is convenient. Engineer B plans and develops the following functions: Explosion observation function: realize the function of equipment parts separation and parts enlargement through explosion/reduction button interaction, and learn and understand the equipment composition. The function needs to realize the motion separation and motion restoration of equipment parts. Components must be able to move in/out of the model with the mouse after separation, and the model can be zoomed in/out proportionally. It is required that the separation and reduction processes are correct and reasonable. Outgoing line identification function: realize the cognitive learning of relevant information of equipment parts through the display, switch and close button interaction of outgoing line. The function shall be realized by clicking the display button. The outgoing line shall appear on the part object in the virtual space and be associated with the relevant information UI of the part. After clicking the switch button, the outgoing line of different parts and the relevant information can be switched. Click the Close button to hide all outgoing lines and relevant information. Transparent observation function: realize observation and learning of internal parts of equipment through transparent button interaction. Click any part of the equipment to pop up the transparency percentage setting slider, and drag the slider to change the transparency of the selected part. Picture in picture observation function: Through the picture in picture observation function, the	12

Table 3 (*continued*)

Typical work task name	Virtual reality application development	
Representative work task		
Task name	Task description	Learning hours
Information display function development	details of the equipment under the state of static or motion can be enlarged and observed. The function requires parameter control such as detailed zooming area, zooming position, zooming ratio and display duration. Upon completion of the above functions, the program engineer shall be handed over for commissioning and optimization.	12
Object motion function development	A unit receives a virtual reality software development business, and the project manager divides and arranges the virtual simulation task. The function development team is required to carry out the function development of the virtual simulation program after the modeling and rendering process is completed. Engineer C is responsible for the object motion function development module. Engineer C obtains the project demand form from the project manager. After communication, the customer needs to show the equipment application process and require the object movement to keep the actual situation consistent, such as movement mode, movement speed and physical phenomena. Engineer C mainly develops the following functions to realize digital twin: Regular motion function: it mainly realizes the basic motion of the object in the virtual environment through linear motion, rotational motion, circular motion and other development commands, and completes the development of equipment installation, commissioning, operation, maintenance and other functions. Composite motion function: It mainly realizes the composite motion of single or multiple objects in the virtual environment through the development command of regular motion, such as translation and rotation, translation and rotation, rotation and vibration, rotation and swing, etc., so as to realize the complex physical phenomenon in equipment application. Parametric motion function: Parametric variable elements are mainly added to regular motion and composite motion to realize the parameterized equation to control the motion path of the object in the virtual environment, and realize the conditional complex linkage function of multiple objects through parameters. Particle special effect application function: mainly control the life cycle, speed, size, color, shape and other contents of the particle special effect through variable parameters, so as to achieve the effect of approaching the real world phenomenon.	12
Development of parameter setting function	Parameter setting function development A unit receives a virtual reality software development business, and the project manager divides and arranges the virtual simulation task. The function development team is required to carry out the function development of the virtual simulation program after the modeling and rendering process is completed. Engineer D is responsible for the parameter setting function development module. Engineer D obtains the project requirement form from the project manager, and through communication, the customer requires the virtual reality program to have convenient function buttons, such as home page return, optimal viewing angle, viewing angle speed, function description, etc. Engineer D plans and develops the following: Home page return function: return to the main interface of the software from any function module interface state. It is convenient for users to quickly switch various functional modules during operation	12

Table 3 (*continued*)

Typical work task name	Virtual reality application development	
Representative work task		
Task name	Task description	Learning hours
Development of parameter setting function	and use, and enhance the friendly interaction experience of users in quickly switching software functions. Best viewing angle function: realize the function of directly switching to the best viewing angle state from any viewing angle state of any module in the virtual space. It is convenient for the user to adjust the perspective change in the operation process and strengthen the friendly interactive experience of the user's perspective operation. Viewpoint speed function: realize the parametric control of camera speed, such as the rotation speed, panning speed, zooming speed of the focus camera, the moving speed and rotation speed of the roaming camera, so as to facilitate the user's customary parameterization setting and adjustment of the view change during the view control process, and strengthen the friendly interactive experience of the user's customary operation.Function introduction: It is used to display/hide the function button name in the pop-up UI after the mouse moves in/out the function button. It is convenient for users to understand and apply the function buttons in the operation process, and strengthen the friendly interactive experience of user operation. Upon completion of the above functions, the program engineer shall be handed over for commissioning and optimization.	12

4.2 Curriculum orientation

Curriculum for augmented and virtual reality can be used as core courses in virtual reality technology applications and related majors, as well as as as extended courses in equipment manufacturing majors. Its function is to align with professional talent training goals and target job positions such as virtual reality and augmented reality development. Through the study of this course, the following skills can be mastered:

a) Understand the basic theoretical knowledge related to augmented and virtual reality;

b) Master the professional basic knowledge of color design, digital painting, scene roaming animation, etc;

c) Capable of digital modeling and rendering, virtual scene UI design, human-computer interaction interface design, and virtual reality scene function development, laying a foundation for relevant course learning and work.

5 Curriculum objectives

5.1 Knowledge objectives

The knowledge objectives are as follows.

a) Get familiar with the laws and regulations related to virtual simulation and the knowledge of civilized production and safety;

b) Master the basic theoretical knowledge of virtual augmented reality;

c) Master the professional basic knowledge of art modeling and 3D structure;

d) Master the professional knowledge of conceptual art and digital painting;

e) Master the professional knowledge of color design and composition aesthetics;

f) Master the knowledge of photography, camera shooting and scene roaming animation;

g) Master 3D model making and animation motion rules;

h) Master relevant knowledge of virtual augmented reality project design and development;

i) Master relevant knowledge of virtual augmented reality software and hardware platform;
j) Understand the expertise of virtual augmented reality project development management, etc.

5.2 Skill objectives

The skill objectives are as follows.
a) Be able to read and correctly understand the design draft and project development plan;
b) Good text, table and image processing capabilities;
c) Good art and design skills;
d) Proficient in the production of various scene modeling;
e) It is capable of rendering and baking virtual scenes;
f) Capable of modifying and drawing multiple texture modes;
g) Animation design and production ability;
h) Practical ability to install, debug and maintain virtual augmented reality software and hardware platform;
i) Develop interactive function of virtual augmented reality engine;
j) Practical ability to apply virtual augmented reality technology.

5.3 Standard of accomplishment

The standards of accomplishment are as follows.
a) Abide by laws and regulations, have a sense of social responsibility and social participation awareness;
b) Pursuing moral and good faith, being honest and trustworthy, loving and dedicated to work, and having the professional spirit of striving for perfection;
c) Have quality awareness, green environmental awareness, safety awareness, information quality and innovative thinking;
d) Have a certain aesthetic and cultural quality;
e) Strong organizational concept, collective consciousness and good sharing attitude, and effective interpersonal communication and cooperation;
f) Have the consciousness and spirit of innovation as well as the awareness of exploring technology, and be able to solve practical problems;
g) Have certain engineering consciousness and benefit consciousness, and be able to systematically and systemically accumulate and learn job tasks.

6 Curriculum content

6.1 Basic theory

The contents of basic theory are as follows.
a) Overview of virtual augmented reality development;
b) Virtual augmented reality model construction;
c) Virtual augmented reality rendering;
d) Designing and making of virtual augmented reality UI;
e) Virtual augmented reality program development.

6.2 Skill practice

6.2.1 Teaching duration arrangement

This curriculum adopts the action oriented teaching concept to implement the "integration of theory and reality" teaching mode in real or simulated working situations. The total class hours of the curriculum are: 60 class hours for virtual model construction and rendering, 48 class hours for UI interface design and making, and 60 class hours for virtual reality application program development, totaling 168 class hours.

6.2.2 Virtual model construction and rendering

See table 4 for learning tasks.

Table 4   Learning tasks of virtual model construction and rendering

NO.	Name of learning task	Class hour	Learning goal	Skill points
1	Application of basic technology of model building and rendering	12	Understand and master Basic knowledge of model construction and rendering	Master the three-dimensional coordinate system and spatial relationship Master the construction principle of 3D model Master the use of modeling and rendering software Understand the construction standard of 3D model
2	3D model construction	24	Capable of 3D model construction	Rule model construction Engraving of model details Optimized model capacity UV unfolding Texture rendering Material setting Optimized materials and colorants
3	3D model rendering	24	Capable of rendering 3D model	Scenario layout Light source parameter setting Camera parameter setting Color correction Special effect addition Setting of shadow type Rendering time optimization Rendering effect output
Note	Total 60 class hours			

6.2.3   UI interface design and making

See table 5 for learning tasks.

Table 5   Learning tasks for UI interface design and production

NO.	Name of learning task	Class hour	Learning goal	Skill points
1	Application of UI interface basic technology	12	Understand and master UI Interface Fundamentals	Master UI design principles Master UI visual design rules Master the use of UI design software Understand UI element classification and composition
2	UI design	12	Capable of completing virtual augmented reality software UI design	Customer demand analysis Page layout design Color scheme design Interactive mode design Interface component design Response mode design

Table 5 (*continued*)

NO.	Name of learning task	Class hour	Learning goal	Skill points
3	UI element fabrication	12	Capable of making UI elements of virtual augmented reality software	Fabrication of button switch Production of input box Making of drop-down menu Make check box Fabrication of dragging slider Fabrication of progress bar Making of message prompt box Fabrication of scroll bar Graphic and text information production
4	UI function development	12	Capable of completing UI function development of virtual augmented reality software	Scenario loading function development Help function development Navigation function development I/O function development Development of operation feedback function Development of view management function
Note			Total 48 class hours	

6.2.4 Virtual reality application development

See table 6 for learning tasks.

Table 6 Learning tasks for virtual reality application development

NO.	Name of learning task	Class hour	Learning goal	Skill points
1	Basic technology application of virtual augmented reality program development	12	Understand and master the basics of virtual augmented reality application development	Knowledge of program development expertise Master the development function and use process of the development engine Master the types and application methods of virtual reality hardware Master the development standard of virtual augmented reality software
2	Role control function development	12	Be able to complete the development of role control function	Role mobile function development Virtual interactive function development Pickup drag function development Voice interaction function development Gesture interactive function development Equipment interactive function development Development of somatosensory interaction function
3	Information display function development	12	Be able to complete the development of role control function	Development of explosion observation function Development of outgoing line identification function Transparent observation function development Development of observation function of picture in picture Highlighted display function development Tree structure function development

Table 6 (*continued*)

NO.	Name of learning task	Class hour	Learning goal	Skill points
4	Object motion function development	12	It can complete the development of object motion function	Regular motion function development Development of composite motion functions Parametric motion function development Particle special effect application function
5	Parameter setting function development	12	Capable of completing parameter setting function development	Home page return to function development Best viewpoint function development Development of view switching function Speed regulation function development Background music function development Text prompt function development
Note	Total 60 class hours			

7 Teaching implementation

7.1 Teaching organization and teaching method

7.1.1 Teaching organization

This curriculum adopts the action oriented teaching concept to implement the "integration of theory and practice" teaching mode under the real or simulated working situations. Centering on the principle of combining theory with practice, it gradually improves students' virtual augmented reality development skills and problem solving abilities through systematic curriculum arrangement, from basic theory explanation of virtual augmented reality development to virtual model construction and rendering, to UI design and production. Classroom teaching mode is adopted to ensure that each student can obtain sufficient guidance and practice opportunities. Meanwhile, interactive links such as case analysis and group discussion are integrated to enhance the fun and effectiveness of learning.

7.1.2 Teaching methods

This course adopts an action oriented teaching method, with tasks as the guide. Representative work tasks derived from practical engineering will be transformed into learning tasks, and relevant knowledge points will be embedded into various learning tasks. Through various learning tasks, relevant knowledge and skills will be imparted, highlighting the cultivation of practical comprehensive vocational abilities.

The teaching method of the course emphasizes the combination of theory and practice. Through various methods such as theoretical lectures and case analysis, task-based learning and team cooperation, project driven teaching, extracurricular expansion and self-directed learning, students' enhanced and virtual reality development skills and comprehensive qualities are comprehensively improved. The teaching methods are as follows:

a) Theory teaching and case analysis. In the classroom, the teacher adopts a systematic teaching method, through PPT presentation, vivid video materials explanation, combined with the classic cases of virtual augmented reality development to conduct in-depth analysis, guide students to learn from the project experience, and enhance their cognition and understanding of virtual projects. In this section, students will learn core knowledge of augmented reality development processes, development standards, modeling and rendering, UI design, etc., helping them establish a solid theoretical foundation.

b) Teamwork learning. Set a series of learning tasks according to the curriculum contents and actual application development links, such as virtual model construction, spatial rendering, UI design and production, program development, etc. The students are divided into groups, each responsible for one task. During the task execution process, students need to give full play to the team spirit, cooperate with each other and solve the problems encountered. Students go through all process links of a specific task to comprehensively improve their ability to solve problems, innovative thinking and teamwork.d rendering, UI design, etc. to help students establish a solid theoretical basis.

c) Task driven instruction. Skill learning through practical involvement in specific tasks of virtual augmented reality development. Each task has clear objectives and requirements to complete specific design, model building, space rendering, UI production and program development within the specified time. In this process, trainees will encounter various practical problems that need to be solved through research and practice. Task-driven teaching methods allow students to master skills in solving practical problems and have a deeper understanding of virtual augmented reality development.
d) Out-class expansion and independent learning. Organize students to visit virtual augmented reality related enterprises, participate in relevant competitions or exhibitions and other activities, so as to let students experience the latest development trends and industrial application prospects of virtual augmented reality technology. At the same time, students are encouraged to carry out autonomous learning by providing rich online learning resources, recommending relevant books and websites. Through the combination of extra expansion and autonomous learning, students can have a deeper understanding of the latest development of virtual augmented reality development technology and improve their professional quality and competitiveness.

7.2 Teaching resources

7.2.1 Site and facilities

The teaching of virtual augmented reality curriculum requires a specially designed virtual training room. It is a training environment specially designed for virtual reality technology development, equipped with advanced VR equipment and development tools. The curriculum participants can design, program, test and optimize the virtual augmented reality application, gain practical experience through practical projects and improve technical skills. The training room provides technical support, practical projects and collaboration opportunities to help trainees master the core skills of virtual reality development and lay a foundation for entering relevant industries or further research.

7.2.2 Hardware and software

The virtual augmented reality training room shall be equipped with advanced hardware and software to support the development and application of virtual reality (VR)   and augmented reality (AR). Hardware includes high performance VR head display, handheld controller, motion tracking system, AR glasses, audio equipment and high configuration computer. In terms of software, the training room provides development platforms (such as Very engine, Unity, Unreal Engine), modeling and animation tools (such as 3Dmax, Brener, and Maya), special SDK (such as Oculus SDK and ARCore), and collaboration and testing tools. Together, these resources create a comprehensive training environment to help trainees and developers learn, practice, and innovate in virtual and augmented reality technologies.

7.2.3 Teaching materials

The teaching materials for virtual augmented reality shall cover a number of key areas to ensure a comprehensive and effective learning experience. Firstly, the detailed curriculum outline and learning objectives shall be provided, and the teaching contents and expected results shall be clear. Then, the basic theory of VR/AR is introduced, including technical principles, application scenarios and relevant computer graphics knowledge. Prepare a comprehensive software user manual covering operating instructions for mainstream development engines and modeling tools. In addition, the main development kit documentation is included. - g. Practical operation curriculums and cases shall be provided, and the development process from simple application to complex scenes shall be demonstrated in detail with relevant code examples. Provide instructional videos and presentations to help students intuitively understand the development process. Design exercises and comprehensive projects to encourage students to practice and solve real-life development problems. Commissioning and testing guidelines are also provided to explain best practices for performance optimization and user experience assessment. Finally, recommend relevant books, online curriculums and technical support resources to provide additional learning materials and problem solutions for students. Through these carefully prepared materials, trainees will be able to fully master the virtual augmented reality development skills and successfully complete the actual project.

7.2.4 Technical support and teachers

Technical support and faculty are equally important in teaching virtual augmented reality curriculums. There is a need to create a team of experienced virtual augmented reality experts and teachers who not only have solid

expertise, but also have extensive teaching experience. In the teaching process, they can provide comprehensive guidance and help for students, and answer the problems encountered by students in learning and practice. Meanwhile, close cooperation with the virtual augmented reality enterprise shall be established to provide timely technical support for students. Such strong technical support and teachers are important guarantee for teaching quality and student learning effect.

8 Teaching evaluation

8.1 Evaluation objective

The teaching evaluation of virtual augmented reality development curriculum aims to comprehensively test the students' mastery of virtual augmented reality development theory, skills and safety specifications, and evaluate the students' adaptability and ability level in the actual work post through diversified evaluation methods. Based on the examination results, the trainees are divided into three levels: A, B and C, so as to provide scientific basis for the follow-up career development and post assignment.

8.2 Evaluation method

8.2.1 Evaluation content

The teaching evaluation of augmented and virtual reality courses is comprehensively and objectively assessed through a combination of process assessments and exam scores, to evaluate students' learning outcomes and course quality. These evaluation methods not only help students to timely understand their learning progress and existing problems, but also provide important basis for teachers to adjust teaching methods and course content, thereby continuously improving the teaching quality and learning effectiveness of the course.

It is recommended to use a combination of process evaluation and summative evaluation for teaching assessment, with process evaluation accounting for 40% to 60% of the total score and summative evaluation accounting for 60% to 40% of the total score. After the course is completed, students' comprehensive vocational abilities will be assessed.

8.2.2 Process assessment and professional competence evaluation

Process assessment is the fundamental evaluation stage of this course, which adopts a scoring or grading system. By establishing clear scoring criteria, it mainly tests the students' learning attitude, participation, and daily homework completion in the classroom. The evaluation content includes classroom attendance rate, enthusiasm for questioning and answering questions, contribution in group discussions, and the quality and timeliness of homework submission.

Adopting the internationally popular COMET (Competency Oriented Model of Educational Targets) assessment method, the comprehensive professional abilities of athletes are evaluated through written tests. COMET International Vocational Ability Assessment Technology starts from 8 key competency indicators, including intuitiveness, functionality, value orientation, economy, work process orientation, social acceptance, environmental friendliness, and creativity. Through 40 specific observation points, it comprehensively and meticulously assesses students. Through this evaluation method, students' comprehensive professional abilities in the field of additive manufacturing can be more accurately understood, and their corresponding professional ability levels can be evaluated based on this, providing important references for their future career planning and development.

8.2.3 Final exam and skill passport

The final exam is the final evaluation stage of this course, which comprehensively tests the students' understanding and mastery of the course knowledge, skills, and methods. The evaluation of exam results adopts a percentage or grade system, and detailed scoring standards are formulated based on the exam outline and requirements to ensure fairness and consistency in the evaluation. The exam covers multiple aspects such as basic principles, operating procedures, equipment maintenance, safety regulations, and practical applications.

The practical performance is the final evaluation stage of the virtual augmented reality development course task, which comprehensively tests students' understanding and mastery of course knowledge, skills, and methods. The evaluation of exam results adopts a percentage or grade system, and detailed scoring standards are formulated based on the exam outline and requirements to ensure fairness and consistency in the evaluation. The exam covers theoretical knowledge, modeling and rendering, UI design and production, program development, and

other aspects of virtual augmented reality development.

At the end of the course, according to the assessment work plan, relevant experts will be organized to conduct a final assessment of the students. The assessment content of the Skill Passport exam closely revolves around the core skills of virtual augmented reality development, including but not limited to model construction and rendering, UI design and production, application development, etc. Based on students' performance in the course learning process, such as process assessment and practical results, the students' skill level will be comprehensively recognized, and corresponding international skill passports will be issued. The specific assessment criteria refer to the "Virtual Augmented Reality Development Competition Skills Standards" to ensure the authority and professionalism of the evaluation.

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