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# Skills for augmented and virtual reality competition

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# Contents

# Foreword

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Chief editor units of this document: Guangzhou City Polytechnic, Hangzhou Polytechnic University

Chief editors of this document: Jiang Tao,Shi Hongxia, Deng Jinlian,Xu Huizhen

Deputy chief editor units of this document: Shunde Polytechnic University (Formerly： Shunde Polytechnic), Hangzhou Veryengine Technology Co.,Ltd., BRICS Academy of Skills Development and Technology Innovation (Xiamen)

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Participate of this document: Li Yongjiu, Ruan Yiyang, Zhu Jiangbo, Duan Xiaodan, Yang Xiaohua, Lu Lixia, Marcelo Vivacqua, Bruno Bisogni, Alberto Ribeiro Oliveira, Jacob Jacobus Greeff, Aslanov Roman, Pua Chang Hong

# Skill for augmented and virtual reality competition

## 1 Scope

This document specifies the basic requirements for the skill training of augmented and virtual reality events, skill requirements of skill passport and performance evaluation methods, including but not limited to the resource requirements for personnel, venue and equipment of augmented and virtual reality contest.
This document applies to the conduct and organization of augmented and virtual reality events.

## 2 Normative references

There are no normative references in this document.

## 3 Terms and definitions

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

**3.1**
**virtual reality; VR**
In an immersive 3D environment generated by a computer, users can interact naturally with the virtual world through head-mounted devices and other tools, thereby obtaining an immersive experience.

**3.2**
**augmented reality; AR**
It is a technology that skillfully integrates virtual information with the real world. It extensively employs a variety of technical means such as multimedia, 3D modeling, real-time tracking and registration, intelligent interaction, and sensing. After simulating and emulating virtual information generated by computers—including text, images, 3D models, music, and videos—this technology applies such information to the real world. The two types of information complement each other, thereby realizing the "enhancement" of the real world.

**3.3**
**mixed reality; MR**
immersive technology that deeply integrates virtual objects with the real environment, and the two can generate natural physical interactions, allowing users to have intuitive interactions in a space where virtual and real are intertwined. Retaining the perception of the real world while giving virtual content a sense of "real existence" is a technological form that lies between augmented reality (AR) and virtual reality (VR)

**3.4**
**extended reality**
general term that encompasses technologies such as virtual reality (VR), augmented reality (AR), mixed reality (MR), etc. It refers to a collection of technologies that integrate virtual information with the real environment through computers, providing users with immersive sensory experiences beyond reality

**3.5**
**render to texture**
technique of rendering the lighting information in the scene environment into a texture and then mapping it back to the scene for restoration

**3.6**
**render**
It refers to the process of generating images from a model using software. Rendering is the final step in computer graphics (CG) and also the stage where the image is ultimately made to conform to the 3D scene. It converts models, scenes, etc., in 3D software into animation or image formats for output.

**3.7**
**shader**
editable program used to implement image rendering and replace fixed rendering pipelines

**3.8**
**interface element**
series of elements in virtual reality application software systems that meet user interaction needs
**3.9**
**script**
set of procedural functions executed as part of an event cascade
**3.10**
**z brush**
so-called digital engraving refers to an art different from traditional manual engraving. Digital engraving can be 3D virtual engraving through digital hand-painting board and computer software
**3.11**
**artificial intelligence**
new technological science that studies and develops theories, methods, technologies, and application systems for simulating, extending, and expanding human intelligence, covering multiple branches such as machine learning, natural language processing, and computer vision
**3.12**
**WebVR/AR**
set of specifications and APIs based on web technology for creating immersive virtual reality and augmented reality experiences in web browsers without the need to install additional applications
**3.13**
**quantum computing**
emerging computing method that utilizes qubits and quantum gates for parallel computing, with higher computing power and faster computing speed
**3.14**
**spatial computing**
integration of technologies such as virtual reality, the Internet of Things, spatial analysis, and AI, allowing the two worlds of virtual and real to perceive, understand, and interact with each other more seamlessly, creating unprecedented experiences. Users can interact with spatial computing applications through virtual reality headsets and other devices

## 4 Competition overview

### 4.1 Competition name and description

#### 4.1.1 Name

Augmented and virtual reality.

#### 4.1.2 Description

Use virtual reality engine and relevant tools to plan, design, code, test, maintain and service virtual reality products.

### 4.2 Professional technical level

Three professional technical levels are set, i.e. level C (primary workers), level B (intermediate workers) and level A (senior worker).

### 4.3 Competition environment conditions

Indoor, normal temperature.

### 4.4 Professional competence characteristics

Capable of technical realization, design and innovation, problem solving and teamwork, and continuous learning and adaptation.

### 4.5 Skill training requirements

#### 4.5.1 Training period

Full-time occupational skill education and continuous education for industry employees shall be determined according to their training objectives and teaching plans.
Term of advanced training: class C not less than 108 standard class hours; B Not less than 72 standard class hours; class A not less than 72 standard class hours.

#### 4.5.2 Training personnel

Level C training personnel shall have skill level certificates of level B and above; level B training personnel shall have level A skill level certificate for this competition; level A training personnel shall have at least 2 years of level A skill level certificate for this competition item or at least 2 years of senior professional and technical post qualification in relevant disciplines.

#### 4.5.3 Training site equipment

Theoretical knowledge training shall be carried out in the place with computer, and the computer shall be installed with virtual engine software meeting relevant parameters; operation skill training shall be carried out in the computer site with professional software equipment. The computer shall be equipped with virtual engine and relevant software meeting relevant parameters, including 3D modeling software, graphic processing software, virtual engine software, etc. See "Training Site Conditions" for specific requirements.

### 4.6 Professional skills requirements

#### 4.6.1 Declaration conditions

##### 4.6.1.1 Class C

A class C certificate can be applied if one of the following conditions is met:

a) Have been engaged in this occupation or relevant occupation for 1 year in total and pass the examination;
b) The technical school of this major or relevant major has completed 1 school year and pass the examination;
c) Obtain the graduation certificate of this major or relevant professional skill school, Can be directly accredited without assessment.

##### 4.6.1.2 Class B

A class B certificate can be applied if one of the following conditions is met:

a) Have been engaged in this occupation or relevant occupation for 3 years, and pass the examination;
b) He/she has been engaged in the occupation or relevant occupation for 1 year after obtaining the class C certificate of the occupation or relevant occupation;
c) The vocational skill education of this major or related majors shall be no less than 3 academic years and the college degree or higher education related major graduation certificate (including current graduates).

##### 4.6.1.3 Class A

Certificate A can be applied if one of the following conditions is met:

a) Have been engaged in the occupation or relevant occupation for 5 years, and pass the examination;
b) Have been engaged in this occupation or relevant occupation for 3 years after obtaining level B certificate of this occupation or relevant occupation;
c) This major or relevant professional professional skill education is studying at least 5 academic years and general higher education college degree or higher graduation certificate (including current graduates).

#### 4.6.2 Direct accreditation criteria

The direct accreditation criteria are as follows

a) Contestants who have won the gold medal in the international finals of the BRICS skills competition may be directly accredited with grade A skills;

b) Contestants who have won the silver medal in the international finals of the BRICS skills competition may be directly accredited with grade B skills;
c) Contestants who have won the bronze medal in the international finals of the BRICS skills competition may be directly accredited with grade C skills.

#### 4.6.3 Assessment method

Divided into theoretical knowledge examination and operational skills assessment. The form of theoretical knowledge examination is a question bank sampling test, mainly assessing the knowledge requirements that practitioners should master in their profession. The assessment of operational skills adopts on-site operation, simulation operation and other methods, mainly assessing the skill level that practitioners should possess in their profession. Theoretical knowledge exams and operational skills assessments are both based on a 100 point system. Those who pass the exam should achieve a score of 60 or above.

#### 4.6.4 Ratio of invigilators, assessors and examinees

The ratio of invigilators to examinees in theoretical knowledge examination shall not be less than 1:20, and each examination room shall not be less than 2 invigilators; The ratio of the assessors to the examinees in the operation skill assessment shall not be less than 1:10, and the assessors shall be odd number of more than 3. Each examinee shall be graded by no less than 3 assessors.

#### 4.6.5 Examination time

The theoretical knowledge examination time of each level shall not be less than 90mins, and the skill examination time shall not be less than 120mins.

#### 4.6.6 Equipment at the assessment site

Theoretical knowledge training should be conducted in places equipped with computers; Training on operational skills should be conducted in places equipped with software for 3D modeling, graphics processing, and virtual engines. Specific requirements shall be in accordance with Chapter 8.

## 5 Basic requirements

### 5.1 Professional ethics

#### 5.1.1 Basic knowledge of professional ethics

The basic knowledge of professional ethics are as follows.
a) Be truthful and provide design related information without concealing or distorting facts. Comply with the contract and complete the design task on time and with quality. Protection of customer trade secrets and intellectual property rights;
b) Fair competition, following market rules and not obtaining competitive advantages by improper means. Respect the labor achievements of peers and do not copy or steal the design originality of others;
c) Social responsibility, considering the impact of the design product on the environment, society and culture to promote sustainable development. Guarantee the safety and reliability of products and safeguard the legitimate rights and interests of consumers;
d) Keep confidential and keep sensitive information and trade secrets in strict confidence. The employee shall still abide by the confidentiality agreement after leaving the post and shall not disclose the relevant information of the original unit.

#### 5.1.2 Code of practice

The codes of practice are as follows.
a) Comply with laws and regulations and be familiar with industry norms;
b) Love the job and respect the customer's needs;
c) Pursue innovation and excellence and strive for effect quality;
d) Participate in team work and respect members' opinions;
e) Constantly improve quality through lifelong continuous learning.

### 5.2 Basic knowledge

#### 5.2.1 Computer software knowledge

The contents of computer software knowledge are as follows.

a) Operating system basis;
b) Computer network foundation;
c) Computer graphics;
d) Software development and test basis.

#### 5.2.2 Art knowledge

The contents of art knowledge are as follows.

a) Plane design;
b) Three-dimensional design;
c) Composition and modeling;
d) Visual communication.

#### 5.2.3 Basic knowledge of virtual reality

The contents of basic knowledge of virtual reality are as follows.

a) Virtual reality engine technology;
b) Structure, principle and technical specifications of virtual reality hardware;
c) Basic human-computer interaction;
d) Typical application of virtual reality system;
e) Basic knowledge of spatial computing.

#### 5.2.4 Information system management knowledge

The contents of information system management knowledge are as follows.

a) Information system maintenance;
b) Evaluation of information systems;
c) Protection of intellectual property rights;
d) Quality management;
e) Information systems project management.

## 6 Work requirements

### 6.1 Professional skill level C (junior worker)

Skill knowledge requirements of level C is shown as table1.

**Table 1 Skill knowledge requirements of level C**

| No. | Occupation function | Content of work | Skill requirements | Relevant knowledge requirements |
|---|---|---|---|---|
| 1 | Scheme design | Project scheme docking | Be able to collect market target information according to the established plan of the team.<br>Sort out the demand documents according to the communication and feedback with customers<br>Be able to make presentation materials according to the requirements of the sales team<br>Be able to collect and summarize customer technical problems.<br>Develop solutions | Market research knowledge<br>Background knowledge of virtual reality industry<br>Basic theoretical knowledge of virtual reality<br>Application knowledge of virtual reality industry |

**Table 1** (*continued*)

| No. | Occupation function | Content of work | Skill requirements | Relevant knowledge requirements |
|---|---|---|---|---|
| 1 | Scheme design | Project scheme management | Tracking the project progress according to the plan<br>Timely feedback of project conditions.<br>Be able to carry out project delivery, acceptance and inspection according to acceptance requirements | Basic knowledge of project management<br>Personnel communication and coordination skills |
| 2 | 3D fabrication | Geometric modeling | Be able to create geometric models using 3D modeling software.<br>Be able to edit the model, such as moving, rotating and zooming.<br>Be able to add color and texture to the model. | Basic operation interface and tools of 3D modeling software.<br>Methods and tools for creating basic geometries such as cubes, spheres, cylinders, etc. |
| | | Scene set-up and rendering | Be able to use 3D design software and virtual engine for model making, import and export.<br>Create scene file and set LOD value of 3D model with virtual reality engine and tools.<br>Capable of creating cameras and modifying relevant parameters using virtual reality engine and relevant tools<br>Create, classify and manage various art resources with virtual reality engine tools. | Virtual reality engine and related tool resource management knowledge.<br>Creation method of virtual reality scene.<br>Light type and setting method.<br>Rendering settings and output methods to generate rendered images. |
| | | Material fabrication and image processing | Be able to edit materials in 3D software and link different types of maps and material channels.<br>The image processing software can be used to modify the material picture, format and color mode. | Be familiar with the material naming rule, material channel and mapping attribute related knowledge, software material editor parameter knowledge.<br>Knowledge about computer image parameters.<br>Knowledge of picture splicing and cutting.<br>Knowledge of picture format.<br>Knowledge about computer color mode. |
| 3 | Interface design | UI edit | Capable of creating copies using template UI.<br>Set attribute of template.<br>Be able to create UI using templates. | Calling method of template UI.<br>Function of each option of UI attribute.<br>Modification method of template UI.<br>Application of common design software. |
| | | UI interactive programming | Be able to write highlight effect control program of UI<br>Be able to write switching procedures between processes.<br>Be able to program and optimize interactive functions | Triggering type and parameters of UI control.<br>UI control response type and response parameters. |

**Table 1** *(continued)*

| No. | Occupation function | Content of work | Skill requirements | Relevant knowledge requirements |
|---|---|---|---|---|
| 4 | Program development | Basic module development | Be able to write basic modules with C # or C++programming language.<br>Be able to design basic actions with game engines such as Unity or Unreal Engine.<br>Compliance with code specifications and project management process. | Basic architecture and module division of VR system.<br>Basic interface and communication mode of VR hardware<br>3D modeling and rendering fundamentals.<br>Basic functions and development process of game engine |
| | | Project testing and commissioning | Master unity or unreal engine debugging tools to debug the system.<br>The functional and performance requirements can be achieved according to the test plan.<br>Be able to record problems and prepare reports.<br>Be able to carry out simple troubleshooting and repair work under the guidance of senior engineer<br>Be able to use standard process specifications for testing. | Basic principle and method of software test.<br>Test points and precautions of VR system.<br>Debugging and log analysis methods.<br>Common software defect types and solutions. |
| | | Document and project management | Sort, edit and save project documents with common office software such as Word and Excel.<br>Be able to extract key information from the project data and summarize it.<br>Be able to apply management tools such as git to document version management in the project | Basic process and specification of project management, including classification, naming and storage of project documents.<br>Project document compilation standards and specifications, including document format, content structure, language style, etc.<br>Basic methods and skills of information retrieval<br>Basic functions and operation methods of common office software and version control tools |
| 5 | Testing and operation | Perform project tests | Perform test tasks according to test guidelines and test cases.<br>Be able to find system defects and record and report test results.<br>Be able to use basic test tools for auxiliary test.<br>Prepare test plan and test report. | Basic concept and interface operation of VR system.<br>Basic test procedures and methods.<br>Design principles and methods of test cases<br>Basic concept and process of defect management.<br>Basic functions and operation methods of test tools. |
| | | | Establish and maintain test environment according to test requirements<br>Be able to configure and manage the software, hardware and network resources required for the test | Configuration requirements and compatibility of virtual reality equipment and relevant software<br>Network basic knowledge and network environment configuration required for test |

**Table 1** *(continued)*

| No. | Occupation function | Content of work | Skill requirements | Relevant knowledge requirements |
|---|---|---|---|---|
| 5 | Testing and operation | Environment erection and maintenance | Be able to solve common problems encountered in test environment configuration.<br>Be able to regularly backup and clean the test environment data<br>Be able to maintain and update the configuration documents of the test environment | Basic concept and application of virtualization technology<br>Basic troubleshooting skills and solutions.<br>Safety requirements for test environment and basic test environment protection measures |

## 6.2 Professional skill level B (intermediate worker)

Skill knowledge requirements of level C is shown as table 2.

**Table 2 Skill knowledge requirements of level B**

| No. | Occupation function | Content of work | Skill requirements | Relevant knowledge requirements |
|---|---|---|---|---|
| 1 | Scheme design | Project scheme docking | Be able to advertise and introduce typical project cases to the market<br>Cooperate with business departments to explore customer demands | Market promotion knowledge<br>Development knowledge of virtual reality industry |
| | | Implementation of project scheme | Be able to answer technical consultation questions from customers and propose solutions<br>Be able to adjust the output solution based on the relevant technical documents of product function and technical architecture according to the project requirements<br>Demonstrate the project and explain the project scheme | Knowledge of virtual reality technology system<br>Project publicity knowledge |
| | | Project scheme management | Communicate the contents of the project plan to the team members and coordinate the work among the posts<br>Organize personnel to make technical breakthrough on test defects according to test results<br>Organize project delivery according to business conditions | Quality control knowledge<br>Project delivery knowledge |

**Table 2** (*continued*)

| No. | Occupation function | Content of work | Skill requirements | Relevant knowledge requirements |
|---|---|---|---|---|
| 2 | 3D fabrication | Optimization of 3D model fabrication | Be able to use 3D modeling software for monomer modeling.<br>Be able to perform character model, scene high model, basic digital carving, basic UV mapping and material adjustment, 3D basic action production and 3D rendering optimization.<br>Be able to use various software modifier commands to create models.<br>Can use polygon modeling tools to create hard surface models.<br>Be able to produce high number of planes and high fine joint model in 3D model.<br>Be able to use the topology tool to make the low number of faces 3D model.<br>UV flattening and distribution of models with UV tools. | High-level modeling process and key points for creating complex geometric features.<br>Software modifier related knowledge.<br>Manufacturing knowledge of hard surface model.<br>Manufacturing knowledge of high and low molds.<br>Knowledge of UV deployment tools. |
| | | UV and material fabrication | UV unfolding of the model and processing of seamless texture of the model.<br>Can use UV layout tools to optimize texture space utilization.<br>The node editor can be used to produce high-quality effects.<br>Be able to use the map making software to make standard PBR process material map.<br>The material production software can be used to output the preset map of each engine material template. | UV unfolding principle and method.<br>Basic Operation of Node Editor.<br>Application methods of advanced texture such as normal texture, concave-convex texture and high-light texture.<br>Manufacturing knowledge of multi-dimensional sub-materials.<br>Map baking knowledge.<br>PBR production process knowledge.<br>Introduction of virtual reality and relevant knowledge on material standards of relevant tools. |
| | | Scene rendering and special effect production | Terrain editing system capable of producing different terrains with VR engine and associated tools.<br>Capable of mapping different surfaces and vegetation using VR engines and associated tools.<br>Be able to use virtual reality engine and relevant tools to build various types of lighting environment.<br>Be able to use virtual reality engine and relevant tools to bake static lighting effect.<br>Be able to simulate wind and gravity with the physical property function of virtual reality engine and relevant tools. | Knowledge of virtual reality engine and related tools terrain editor.<br>Virtual reality introduces knowledge of the surface and vegetation systems and related tools.<br>Illumination system knowledge of virtual reality engine and relevant tools.<br>Baking knowledge of static light map.<br>Introduction of virtual reality and application knowledge of physical modules of relevant tools.<br>Virtual reality engine and relevant tools collision body knowledge. |

**Table 2** (*continued*)

| No. | Occupation function | Content of work | Skill requirements | Relevant knowledge requirements |
|---|---|---|---|---|
| 2 | 3D fabrication | Scene rendering and special effect production | Capable of setting collision and walkable areas using the VR engine and associated tools.<br>Be able to use the virtual reality engine and related tools to set different styles of sky box.<br>Be able to use virtual reality engine and relevant tools to make special effect materials.<br>Particle effect system that can use virtual reality engine and related tools to adjust particle parameters.<br>1The virtual reality engine and relevant tools can be used to set fog effects such as large fog and index fog. | Virtual reality engine and related tools sky setup.<br>Special effect material related knowledge.<br>Related knowledge of particle system.<br>Knowledge of fog effect setting. |
| | | Animation and character binding | Creation of animation using key frames.<br>Be able to make simple animation, such as walking cycle and mechanical movement of characters.<br>Bone system capable of making adaptive models using software.<br>Be able to use software to bind and skin the model.<br>The action data can be exported and imported in segments. | Key frame production related knowledge.<br>Related knowledge of bone binding system Related knowledge of skin system.<br>Basic knowledge of human dynamics animation.<br>Import and export of action file. |
| 3 | Interface design | UI making | Capable of creating copies using template UI.<br>Set attribute of template.<br>Be able to create simple UI using templates.<br>Be able to create UI using design software. | Calling method of template UI.<br>Function of each option of UI attribute.<br>Modification methods for template UI.<br>Application of common UI design software. |
| | | UI interactive programming | Be able to write highlight effect control program of UI.<br>Be able to write switching procedures between processes.<br>Be able to write and optimize complex interactive function programs. | Triggering type and parameters of UI control.<br>Response type and response parameters of UI control. |
| 4 | Program development | System module integration | Be able to use Unity/Unreal Engine and other VR development environments to develop common modules of the system.<br>Be able to apply common data structures and algorithms to VR development. | Basic concept and framework of virtual reality technology.<br>Principles and methods of object-oriented programming.<br>How the game engine or development framework works. |

**Table 2** (*continued*)

| No. | Occupation function | Content of work | Skill requirements | Relevant knowledge requirements |
|---|---|---|---|---|
| 4 | Program development | System module integration | The interface design and communication protocol can be used to realize the docking between modules. | Development process and management method of virtual reality project.<br>Knowledge of hardware interface and communication protocol. |
| | | Real-time rendering and performance optimization | Be able to use the rendering pipeline to manage the rendering status.<br>Basic rendering performance analysis and tuning.<br>Be able to optimize rendering with common graphic optimization techniques and algorithms.<br>Resource management strategy can be used to reduce the occupation of rendering resources.<br>Realize LOD technology. | Principle and process of real-time rendering.<br>Basic principles and methods of rendering performance optimization.<br>Common graphic processing technologies such as texture compression and shadow generation.<br>Operating principle and characteristics of modern graphics hardware.<br>Parallel computing and multi-thread programming knowledge. |
| | | Design and development of interactive UI | UI systems such as unity or unreal Engine can be used to design and implement interactive logic according to requirements.<br>Be able to make interface elements with UI Photoshop, Illuminator and other tools.<br>Animation and transitional effects. | Human-machine interaction principle and user experience design principle.<br>VR's unique interaction mode and user behavior mode.<br>UI design specifications and presentation path.<br>Application of design elements such as color, layout and icons.<br>Current latest UI design trends and technologies. |
| | | Documentation | Capable of describing system functions and design ideas.<br>Be able to use Markdown, Word and other tools to write documents.<br>Capable of system maintenance and troubleshooting.<br>Compliance with code specifications and project management process. | Standards and specifications for compiling software development documents.<br>Basic process and method of system maintenance and troubleshooting.<br>Project management knowledge and software development process.<br>Code review and version control methods.<br>Industry dynamics and technology development trend. |
| 5 | Testing and operation | Perform modular test tasks | Perform the assigned test tasks according to the test plan.<br>Be able to use test management tools to record test results and defects. | Basic modules and functions of VR system.<br>Common test types and test scenarios.<br>Cooperative process of test and development. |

**Table 2** (*continued*)

| No. | Occupation function | Content of work | Skill requirements | Relevant knowledge requirements |
|---|---|---|---|---|
| 5 | Testing and operation | Perform modular test tasks | Test cases can be modified and extended according to requirements.<br>Be able to analyze test results, identify potential problems and communicate with developers.<br>Be able to assist in preparing the test report. | Defect management process and report specification.<br>Configuration and construction method of test environment. |
| | | System monitoring and maintenance | Be able to use monitoring tools to regularly check the system status and performance indicators.<br>Be able to locate and preliminarily handle common system faults.<br>Be able to assist system backup and recovery operation.<br>Record and report problems and solutions during system maintenance.<br>Keep good communication with users and development teams to ensure that problems are solved in time. | Basic principle and method of system monitoring.<br>Importance and implementation method of backup and recovery.<br>Analysis and interpretation skills of system logs.<br>Service Level Agreements (SLA) and Customer Satisfaction Requirements. |

### 6.3 Professional skill level A (senior worker)

Skill knowledge requirements of level C is shown as table 3.

**Table 3 Skill knowledge requirements of level A**

| No. | Occupation function | Content of work | Skill requirements | Relevant knowledge requirements |
|---|---|---|---|---|
| 1 | Scheme design | Project demand analysis | Cooperate with business departments to guide customer demands.<br>Be able to tap the general needs of the industry, extract the product value characteristics, and sort out the competitive product analysis report.<br>Be able to establish target market analysis model and put forward suggestions on market strategy formulation. | Key points of system demand analysis<br>Marketing knowledge |
| | | Formulation of project scheme | Be able to output supporting documents of products according to product function design and technical architecture, and design solutions according to project requirements<br>Participate in project structure design and product design, and put forward constructive suggestions. | Analysis knowledge of virtual reality system architecture.<br>Virtual reality product design knowledge. |

**Table 3** *(continued)*

| No. | Occupation function | Content of work | Skill requirements | Relevant knowledge requirements |
|---|---|---|---|---|
| 1 | Scheme design | Project management | Complete the project planning according to the actual situation and output the project planning scheme.<br>Be able to coordinate resources of all parties and overall control project progress and quality.<br>Be able to identify various risks and handle various emergencies in the project life cycle. | Project planning knowledge.<br>Risk control knowledge.<br>Virtual reality engine and related tools and project source code security review knowledge. |
| | | Project training | Be able to prepare technical personnel training plan.<br>Prepare technical training materials.<br>Be able to provide professional ability guidance training for relevant employees. | Formulation method of training plan.<br>Preparation method of technical training materials. |
| 2 | 3D design | Independent artwork design | Be able to use hand painting techniques to express painting elements such as figures, animals and landscapes.<br>Be able to use computer software to design and produce original artwork. | Basic methods of original figure design and scene design.<br>Knowledge points of hand-painting technique and color theory.<br>Scene design skills under different times, cultures and styles.<br>The basic process of animation production includes preliminary planning, script creation, role design, scene design, animation production, special effect production and other links. |
| | | 3D model design and fabrication | 3D character advanced and advanced digital carving, complex scene and article production, advanced processing of hard surface, next generation PBR mapping, bone binding and bone animation and other advanced skills.<br>High-level UV workflow, PBR material production and detail mapping.<br>Use the node material editor to create a complex node material network to achieve a realistic visual effect. Master the application methods of various texture maps. | Skill knowledge of polygon modeling, surface modeling, volume element modeling, and advanced tools such as Boolean operations and subdivision surfaces.<br>Advanced rendering technologies, including global illumination, ray tracing and rendering optimization.<br>Function and application method of material editor, map knowledge and usage,concave-convex map, ambient light mask map, displacement map, etc. |
| | | Animation and visual effects | Binding of character bone.<br>Skinning techniques are used to allow the model to properly deform during bone movement.<br>Create animation with motion capture technology.<br>Making facial expression animation and action sequence. | Skeleton animation technology theory.<br>Weight adjustment and optimization methods.<br>Key frame animation and motion capture technology can produce complex character animation.<br>Master the basic principles and skills of creating facial expression animation and |

**Table 3** (*continued*)

| No. | Occupation function | Content of work | Skill requirements | Relevant knowledge requirements |
|---|---|---|---|---|
| 2 | 3D design | Animation and visual effects | Set and optimize the rendering of light scenes, including Global Illumination and Ray Tracing, HDRI (High Dynamic Range Image), etc.<br>Set rendering parameters to generate still images or animation videos. | detailed action sequence.<br>Master the knowledge points of light types and characteristics.<br>Get familiar with advanced lighting settings and rendering skills, including lighting layout. |
| | | AI Generative Formula | Proficient in operating mainstream AI generative design tools (such as 2D to 3D tools, AI plugins, intelligent rendering and material generation tools)<br>Be able to break down workflows according to project requirements and adapt AI tools to traditional workflows in a reasonable manner<br>Master the parameter tuning and fine tuning techniques for AI generated results<br>Capable of cross disciplinary integration, seamlessly integrating AI generated content with traditional 3D design results<br>Capable of customizing AI generation solutions for specific industry scenarios, such as gaming, film and television, architecture, etc<br>Master the quality evaluation and optimization methods of AI generated content | Principles of generative AI core technology<br>Cross application knowledge of computer graphics and AI<br>Basic methods for 3D data processing and AI model training<br>Ethical and legal risk perception of AI generated results<br>Deep application skills of mainstream AI design tools<br>Collaborative workflow between AI and traditional 3D software<br>Industry specific dataset construction and model fine-tuning methods |
| 3 | Interface design | UI design | Be able to plan interface design according to user needs.<br>Be able to use design software for interface design.<br>Interface interactive design. | Basic introduction, basic relationship and psychological effect of color.<br>Definition, style, design specification and process of icons and font selection, alignment and layout, graphic elements, negative space and picture processing in graphic design.<br>Usage of common design software.<br>Basic principles and common design modes of interactive design. |
| | | UI optimization | User demand analysis.<br>Capable of using front-end technology. | User research methods, such as user interview, questionnaire survey, user observation, etc.<br>HTML, CSS and other front-end technologies. |

**Table 3** (*continued*)

| No. | Occupation function | Content of work | Skill requirements | Relevant knowledge requirements |
|---|---|---|---|---|
| 4 | Program development | Development of system core module | Be able to design mainstream development framework with C++or unity/unreal engine, etc.<br>Capable of GPU programming and high-performance graphic rendering algorithms.<br>Be able to design extensible and high-performance system modules.<br>Capable of 3D modeling and animation. | Virtual reality technology and principle.<br>Key technologies such as real-time rendering, physical simulation and human-computer interaction.<br>Development trend of cutting-edge graphics technology.<br>Multi-thread programming and parallel computing theory.<br>Performance tuning and memory management technology. |
| | | Real-time rendering program development | Use GPU shader to optimize rendering efficiency and effect.<br>Be able to use real-time rendering pipeline optimization for performance analysis.<br>It can use light and shadow effects, post-processing and other technologies to improve the visual effect.<br>Be able to design efficient rendering resource management strategies. | Principles and implementation details of rendering technology.<br>Advanced rendering technologies such as light tracking and ambient light shielding.<br>Latest research and trend of real-time rendering.<br>Commonly used optimization algorithms in data structure.<br>Use and characteristics of various rendering engines. |
| | | Interactive logic and user interface development | Intuitive interactive logic can be realized by using more than one UI design tool.<br>Realistic physical interaction effect can be realized by using physical engine.<br>Audio and visual synchronization technology.<br>Multi-platform adaptation and cross-platform development. | Human-machine interaction theory and design principle.<br>Application of animation and motion law in interface interaction.<br>Application of voice recognition, gesture recognition and other new technologies in VR.<br>Application of data drive and user behavior analysis in interface optimization.<br>Accessibility and accessibility design awareness. |
| | | System optimization | Be able to use more than 2 kinds of performance analysis tools and debugging means to complete the performance analysis and optimization of the system level.<br>Be able to use code optimization strategies and skills to achieve system optimization.<br>Be able to handle complex problems such as memory leakage and multi-thread conflict.<br>Be able to design optimization strategies for different hardware platforms. | Computer architecture impact on performance.<br>Common performance test methods and standards.<br>Application of hardware acceleration and parallel processing technology in VR system.<br>Compiler optimization and underlying technical principles.<br>Knowledge background of network security and data security. |

**Table 3** (*continued*)

| No. | Occupation function | Content of work | Skill requirements | Relevant knowledge requirements |
|---|---|---|---|---|
| 5 | Testing and operation | Design and execution tests | Be able to complete system test with unit test, integration test, performance test and other test methods.<br>Be able to design complex test schemes to ensure that all critical scenarios are covered.<br>Be able to use automated test tools (such as Selenium, unity test framework, etc.) to complete large-scale tests.<br>Be able to complete the comprehensive items in the test and put forward solutions.<br>Prepare test report. | Software test principle and presentation path.<br>Structure of VR system and working principle of core module.<br>AI-driven or other latest test technologies and development trends.<br>Quality standard, evaluation method and risk identification technology of software test.<br>Compatibility and performance test standard of VR equipment. |
| | | System operation and maintenance | Be able to use common test tools to complete pressure test and load test and evaluate the performance of the system under high load.<br>Be able to analyze and optimize system performance bottlenecks.<br>Be able to use more than 2 kinds of monitoring tools to monitor the system status and user feedback in real time.<br>Develop and implement effective troubleshooting and recovery strategies. | Common system stability guarantee technology.<br>Common performance optimization techniques and methods.<br>Impact of network, storage and other infrastructures on VR system.<br>System backup and recovery process.<br>Software quality control standard and process. |

## 7 Weight table

### 7.1 Weight table of theoretical knowledge

Weight table of theoretical knowledge is shown as table 4.

**Table 4 Weight table of theoretical knowledge**

| Item | | Skill Level | | |
|---|---|---|---|---|
| | | Level C（%） | Level B（%） | Level A（%） |
| Basic requirements | Professional ethics | 5 | 5 | 5 |
| | Basic knowledge | 15 | - | - |
| Relevant knowledge requirements | Conceptual design | 10 | 15 | 20 |
| | 3D fabrication | 25 | 20 | 15 |
| | Interface design | 20 | 25 | 15 |
| | Program development | 20 | 25 | 30 |
| | Testing and operation | 5 | 10 | 15 |
| Total | | 100 | 100 | 100 |

### 7.2 Skill requirement weighting table

Skill requirement weighting is shown as table 5.

**Table 5 Weight table of skill requirement**

| Item | | Skill Level | | |
|---|---|---|---|---|
| | | Level C（%） | Level B（%） | Level A（%） |
| Skill requirement | Conceptual design | 15 | 20 | 25 |
| | 3D fabrication | 30 | 25 | 15 |
| | Interface design | 25 | 20 | 10 |
| | Program development | 20 | 25 | 30 |
| | Testing and operation | 10 | 10 | 20 |
| Total | | 100 | 100 | 100 |

## 8 Training site conditions

### 8.1 Theoretical knowledge training site

Theoretical knowledge training shall be conducted in standard classrooms or on online platforms, and the specific requirements for the computer shall be as follows:

a) CPU: i5 or above, unlimited clock speed;
b) Memory: 4GB or above;
c) Monitor: 19 inches, 1920 × 1080 resolution and above.

### 8.2 Operation skill training site

#### 8.2.1 Hardware requirements

##### 8.2.1.1 Computer requirements

The computer requirements are as follows.

a) CPU: ≥ 10 generations of Intel Core i7 or equivalent AMD processor;
b) Memory: ≥ 16GB DDR4;
c) Display: ≥ 23.8 inches, 1920 × 1080 resolution and above;
d) Hard disk space: ≥ 256 GB solid state hard disk+1TB mechanical hard disk.

##### 8.2.1.2 Operating hardware

The hardware requirements for operation should include:

a) Verification devices that enable users to interact with virtual environments;
b) High resolution and low latency head mounted displays (HMDs);
c) Sensors or external tracking devices built into HMD;
d) VR headset device with a resolution of no less than 1080P, providing immersive visual experience and head tracking function;
e) Input devices, including handheld controllers, data gloves, motion capture suits, etc., are used to enable user interaction with virtual environments;
f) Location tracking devices are used to capture the user's position and actions in space, achieving accurate spatial positioning;
g) Interactive projector, in AR applications, can directly project virtual information onto physical objects, providing an interactive experience;
h) Smart glasses, such as Google Glass Enterprise Edition 2, can add virtual elements to the user's

field of view;
i) AR head mounted display provides a mixed reality experience that combines AR and VR elements, allowing users to interact with 3D holograms in the real world;
j) Optical components and sensors are used in head mounted devices to enhance the realism and responsiveness of virtual images;
k) Supporting peripherals such as controllers, cameras, motion sensing devices, and other interactive and feedback devices to enhance user experience.

#### 8.2.2 Software requirements

The software requirements are as follows.
a) Quick set-up of virtual 3D scenes;
b) Augmented reality development capabilities;
c) Development function of interactive media;
d) Development and design function of virtual simulation software;
e) Editor operational environment;
f) Modeling processing function;
g) Modeling rendering function;
h) Image processing function;
i) Text and table processing function.

### 8.3 Software and hardware adaptation requirements for special groups

#### 8.3.1 Hardware facilities

The hardware facility requirements are as follows:
a) The site space follows the principle of "1.5 meter turning radius";
b) The VR interactive interface needs to synchronously support dual modes of "voice command+head posture control" to reduce hand operation pressure;
c) The tactile feedback gloves are equipped with electromyography sensors that can automatically recognize the grip strength of users with muscle weakness;
d) VR devices integrate sound wave navigation technology to mark obstacles through 3D spatial audio;
e) Cooperate with the vibration frequency changes of gloves to replace visual guidance;
f) Braille signage for the venue, embedded with tactile relief buttons in the VR menu, supporting dynamic touch feedback of Braille points;
g) VR video opens sign language animation subtitles, and voice commands are synchronized to generate dynamic text floating windows;
h) The tactile gloves are designed with an alarm vibration mode to replace traditional sound prompts.

#### 8.3.2 Software system

The software system requirements are as follows:
a) The underlying architecture of the UI strictly follows the WCAG 2.1 AA standard: virtual button contrast ratio ⩾ 4.5:1 (small text ⩾ 7:1), focal area ⩾ 48x48px, all dynamic interfaces automatically load ARIA tags, synchronized voice playback when VR menus are expanded, and screen reader latency ⩽ 150ms;
b) The cognitive assistance system provides spatial anchor memory function, marking frequently visited locations through both voice and tactile cues;
c) VR text is automatically converted to "voice summary+keyword highlighting" mode, and important information is synchronized to trigger glove pulse vibration, enhancing multi sensory memory.

## 9 Security guarantee

### 9.1 Hardware and device security

#### 9.1.1 Physical security design

The equipment casing must comply with safety standards such as anti drop and fire prevention to avoid physical injury caused by equipment failure during user use.
The connecting wire should have anti winding design to reduce the risk of tripping during user activities.

#### 9.1.2 Electrical safety regulations

The power adapter needs to pass safety certification (such as UL, CE, etc.) to prevent issues such as leakage and overload. The operating temperature range of the equipment should be clearly defined to avoid overheating caused by prolonged use.

### 9.2 Data security and privacy protection

#### 9.2.1 Data collection and storage

Clearly define the scope of collection for user data (such as biometric and behavioral data) and obtain explicit authorization from the user.
Sensitive data (such as eye tracking data and physiological indicators) need to be encrypted and stored to avoid leakage.

#### 9.2.2 Data transmission security

Using encryption protocols (such as TLS 1.3) to transmit VR content and user data to prevent man in the middle attacks. When synchronizing data in the cloud, two-way authentication is required to ensure data integrity.

#### 9.2.3 Privacy protection clause

Prohibit the unauthorized use of user data for advertising targeting and other purposes, and clarify the data deletion mechanism.

### 9.3 User interaction and experience security

#### 9.3.1 Prevention of dizziness and health protection

The frame rate should be kept above 90fps, and the delay should be controlled within 20ms to reduce dizziness.
Set usage duration reminders to prevent users from experiencing vision or cervical spine problems due to prolonged immersion.

#### 9.3.2 Space positioning safety

The positioning system needs to accurately identify obstacles and remind users to avoid collisions through visual or tactile feedback.
In emergency situations, the "safety boundary" function can be triggered to restrict the user's activity range.

#### 9.3.3 Interaction behavior norms

Violent and aggressive content in virtual scenes should be graded to avoid adverse effects on user psychology.
Prohibit unauthorized virtual item transactions to prevent economic fraud.

### 9.4 Content security and compliance

#### 9.4.1 Content review mechanism

Establish review standards for VR content and prohibit the dissemination of illegal content such as pornography, terror, hatred, etc.
Introduce AI assisted review, combined with manual review to ensure content compliance.

#### 9.4.2 Copyright protection

Standardize the copyright ownership of VR content and prevent the circulation of pirated resources.
Track the source of content through digital watermarking and other technologies to combat infringement.

### 9.5 Network and system security

#### 9.5.1 Vulnerability management

Regularly update the firmware and operating system of VR devices to fix vulnerabilities such as buffer overflow and remote code execution.
Establish a vulnerability disclosure mechanism and encourage white hat hackers to report security issues.

#### 9.5.2 Network attack protection

Deploy firewalls and intrusion detection systems (IDS) to prevent DDoS attacks and malware injection.
Secure the VR server and restrict the opening of non essential ports.

### 9.6 Sustainable design

Encourage green VR practices such as low polygon modeling and server-side rendering.

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