

# Programming of Virtual Reality System for Swimming Teaching

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**Abstract.** As swimming is a kind of water sports, swimming teachers generally find it difficult to express demonstration actions in practice teaching by using appropriate manners. Furthermore, teaching effectiveness will be optimized by avoiding technical barriers in learning, thus realizing great transformation and innovation of swimming teaching. This research combines three-dimensional virtual reality simulation and database technology, provides precise digital management platform for real-time data acquisition and monitoring system, and lets users can control the objects as they were right on the scene. With the help of VR technology, designers can not only publicize it to the mass, but also present it to decision makers for modified opinions applied in swimming teaching area. The purpose of this research is trying to design a virtual reality system to suit the complex demand of swimming teaching and promote the outcome of the course.

**Keywords:** Virtual reality technology · Swimming teaching · Programming · System · VRP-SDK · Procedures of integrating database

## 1 Introduction

Virtual Reality (VR) technology, also called virtual environment technology, is a rapidly developed technology of computer-generated simulation. Involving computer graphics, multimedia, artificial intelligence, multi-sensor and network parallel processing, it enables computer to generate three-dimension images. By presenting visual, auditory and touching sense as graphics and animations, it can provide users with a feeling that they were right on the scene. Besides, users can also personally operate and practice this software to enjoy an interaction with the virtual environment. That is because such software has altered the passive and static information transfer of traditional computer aided design [1]. Therefore, VR can be defined as a computer system able to generate and experience a virtual world. By generating various virtual environments, such software could provide users a feeling of being right on the scene via visual, auditory and touching experience. In terms of virtual world, it refers to the set of virtual environments or given simulation objects.

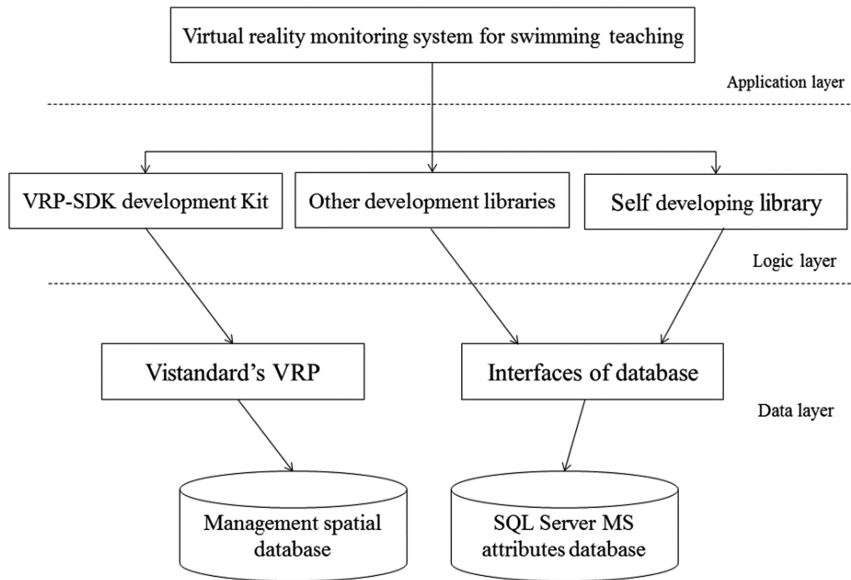
## 2 Selection of VR Software in Swimming Teaching

VRP-SDK, developed by Vi standard Digital Technology Co., Ltd., is a powerful software tool for junior and senior virtual reality developer. It is compatible with various Windows operating systems, with friendly editing interface, effective and efficient workflow, powerful capabilities of 3D graphics and arbitrary and real-time 3D display. Besides, this software supports the simultaneous installation and usage of multiple versions of 3ds Max (3ds Max 5, 6, 7, 8 and 9). Accurate navigation map is applicable in this software, even with a precision of 9999999.00. Furthermore, angle switching is also possible in this software, and navigation map can be amplified and reduced by user-defined navigation arrow. With the attribute of efficient and precise physical collision, it is easy to realize high-precision capture. This software supports the import and export of model or animation camera. It also supports various ways of selection, such as point selection, frame selection, round selection, irregular polygon selection and anti-selection. While handling engineering document, fog effect can be used to enhance the scene depth [2]. In addition, various sun halos can be edited and selected to simulate realistic halo effect. Furthermore, abundant styles of sky boxes can be edited and selected to simulate realistic sky. This software supports the display and modification of object sizes. Besides, the object can be copied, mirrored, rotated, zoomed and translated along random reference axis. It supports multi-view display by physical display, gizmo display and point display [3]. In this software, the heights, facade materials, colors and textures of buildings can be randomly changed. It supports ATX dynamic mapping with user-defined ATX start frame and playing times. For its powerful map manager, it is easy to realize automated mapping management and optimization in this software.

## 3 Overall Framework of System

Data is the core of pipe network management system. Thus, using safe and efficient database technology to manage massive pipeline network is of importance to develop data pipe network information management system. Currently, the development trend of virtual reality technology is to manage data by connecting spatial data engine to a relational database [4].

In this work, actions of breaststroke teaching were named one by one to constitute the components of spatial database and relational database. Underwater scene of swimming pool was managed by VRP that redeveloped for the interaction of VRP-SDK and virtual reality model. Relevant data of any object selected by users could be searched in relational database according to the name of object. Figure 1 showed the overall framework of system.



**Fig. 1.** Overall framework of system

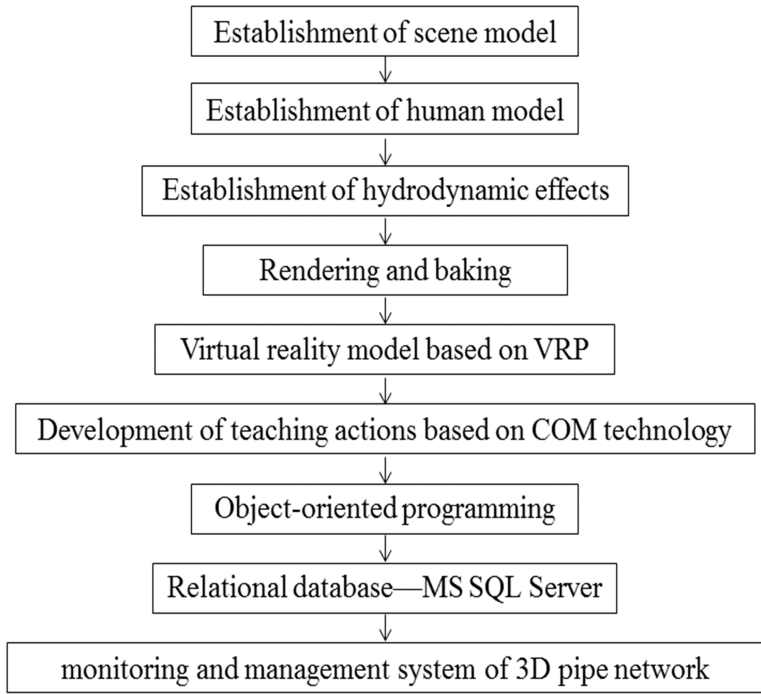
## 4 Basic Development Flow of VR Experiment Courseware of Swimming Teaching

In this work, the optimum visual, auditory and sensory effects of breaststroke teaching were presented using a pipeline network simulation system of breaststroke teaching. Such system was built using advanced VR technology, computer graphics technology and relational database technology. Besides its decision-making function of network planning and transformation for teachers and management departments, it also provides precise digital management platform for real-time data acquisition and monitoring system. Procedures of integrating database includes modeling, material setting, light setting, camera setting, rendering and baking, exporting models to VRP and the secondary development by Borland Delphi. Figure 2 showed the basic ideas of this design.

To build this system, the procedures includes modeling, material setting, light setting, camera setting, rendering and baking, and exporting models to VRP. Then, relational database is integrated after the secondary development via object oriented development tools.

### 4.1 Establishment of Scene Model

After the 3D model of the whole swimming pool being pretreated by AutoCAD, the three-dimensional model was built by 3dmax. The sizes of scene model should be the real sizes of swimming pool, using the unit in millimeter.



**Fig. 2.** Basic flow chart of research design and development

#### **4.2 Establishment of Human Model**

After the establishment of scene model, static model of human was established. Lighting Map and Complete Map were commonly used for their good compatibility. The formats of maps included jpg, bmp, tga, png and dds.

#### **4.3 Establishment of Hydrodynamic Effects**

Photorealistic rendering of swimming scene required reasonable parameters of fluid mechanics. The parameters of this system were the default settings. In this system, Target Spot and Skylight were used, and the shadow type was set as Area Shadows. Hydrodynamic parameters in this scene were set according to the standards of swimming hydrodynamics.

#### **4.4 Rendering and Baking**

Virtual reality dynamic effect of breaststroke teaching was built according to the basic actions, emphasis and difficulty of actions, as well as all the details of demonstration teaching.

#### **4.4.1 3dsMax Rendering**

After the establishment of human model and dynamic effect of breaststroke teaching, the default rendering Scanline of 3dsMax was used. The effect of rendering effect in VRP was affected by the modeling and rendering of 3dsMax, such as the quality of rendering and numbers of error.

Although advanced light rendering can generate the effect of global illumination and real diffuse reflection, the rendering effect was also good while using Scanline under standard light. To strengthen the realistic sense, advanced light rendering of Max was used in this system.

#### **4.4.2 3dsMax Baking**

Baking referred to bringing the lighting of objects in MAX to the virtual reality environment through maps, thus achieving the realistic sense. However, it was unreal if introducing objects into system without baking. The operation of baking in 3dsMax was inputting the order of “Rendering | Render To Texture”.

### **4.5 Optimization of Virtual Reality Model Based on VRP**

Using virtual reality software VRP, several modules were added to breaststroke teaching model, such as real-time rendering, skeletal animation, sound simulation, particle system and physics engine. Then, the entire scene came to be vivid and lifelike, greatly increasing users’ interactivity.

### **4.6 Secondary Development Based on COM Technology**

In this work, Microsoft’s Component Object Model (COM) technology was used to integrate the optimized three-dimensional VR model of steel plant into the system. Besides, the core function and 3D engine of VRP components were used to further expand the function of three-dimensional VR model.

### **4.7 Object-Oriented Programming**

With the help of object oriented development tool Delphi of Borland, this system was provided with an information control platform for the pipe network of breaststroke teaching. Thus, it was possible to realize the simulation of pipe network roaming based on DirectX technology, as well as combination of network layers.

### **4.8 Relational Database—MS SQL Server**

Database of the main actions of breaststroke teaching was built to realize the dynamic management and maintenance of attributes database. Thus, it was possible to realize the inquiry of device information and spatial information of pipe network, as well as the analysis and management of assistant decisions.

#### 4.9 Monitoring and Management System of 3D Pipe Network

In this stage, virtual experiment courseware was further perfected based on the feedback information from the test of virtual classroom and application of teaching.

### 5 Conclusions and Suggestions

Virtual environment was built based on the combination of real data models using VR technology, strictly following the standards and requirements of engineering project design. Traditional designs were almost presented through ichnographies, elevations, and aerial views. These expressions are flat and static, totally different from the VR environment, which is three-dimensional and dynamic. Using VR technology is an ideal way to present design results. With the help of VR technology, designers can not only publicize it to the mass, but also present it to decision makers for modified opinions. With the three-dimensional, intuitive and scientific presentations of digital visualization system, users can control the objects as they were right on the scene. Therefore, both professional and non-professionals will enjoy personal experiences and understandings in this system in project presentation, demonstration, review, publicity and reporting.

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