

# Application of Virtual Reality Technology in Transportation Design and Engineering Analysis

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**Keywords:** Virtual Reality Technology; Transportation Design; Engineering; Automotive Industry

**Abstract:** With the continuous development of computer technology, virtual reality technology is becoming more and more popular among different industries. This article mainly introduces some components of basic visualization framework and demonstrates the application of virtual technology in virtual reality, such as in the use of transportation design and engineering analysis. In the end, the author puts forward some opinions on visualization technology, and expounds the development trend and research direction of visualization technology in automotive industry.

## Introduction

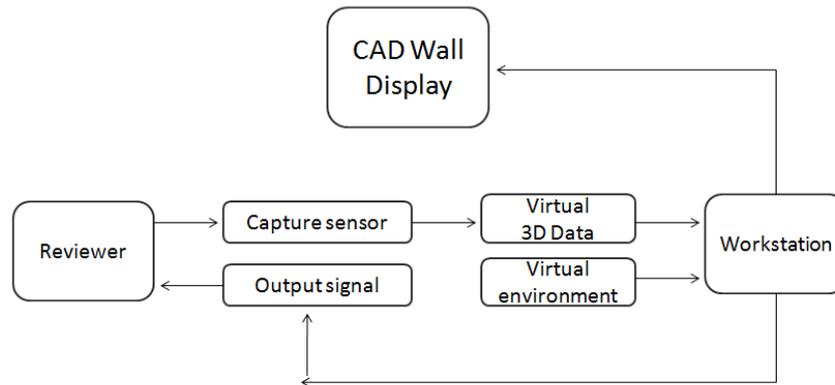
With the continuous development of the automotive industry, the competition among automotive companies becomes more and more fierce. To accelerate the development of new types of vehicles, the leading time for designing new types of vehicles was shortened by manufacturers to occupy the market as soon as possible. Therefore, we must reduce the development cost of new designs and improve the competitiveness of our products in the market. Therefore, new technologies and new methods will be gradually applied in the developing process of new vehicles to ensure the leading time & D period can be shortened [1].

Virtual Reality Technology (VRT) is a kind of immersion received as the real scene in the real space by users to experience and perceive the three-dimensional virtual space by creating a three-dimensional virtual space using computers. Virtual technology is closely related to many technologies, [2] such as 3D modeling technology, graphic display technology, sensor technology and artificial intelligence technology. Virtual technology creates realistic 3D scene models from computer data and adds materials to the objects in the virtual scene for processing, so that users can review the virtual cars in the “virtual world”. Computers and new technologies are very important for the development of human-computer interaction techniques. With the continuous development of virtual technology, people are constantly expanding the scope of virtual technology with virtual technology being used in flight training, architectural design, game development and industrial design and other fields.

## 1. The Components of Virtual Reality System

Most virtual systems consist of input sensors, output sensors, 3D modeling and control platforms, as shown in Figure 1. Use movements, collection behavior or signal received from special input are used to execute command signals. The virtual system software analyzes the input, identifies and calculates the input signals and necessary scene elements selected in the 3D database, and present them to reviewers. [3]. The users receive feedback from the 3D display device and then determine the behavior of the input module. Most virtual input modules receive input signals in various ways, most of which were used by receiving the position and posture of the head. The main signal input devices for users' hands include: digital gloves, 3D mouse, biological detection device, head tracking device and voice input device. Output module: Simulating various human senses through virtual technology and equipment is the ultimate goal of virtual reality. The user absorbs and transforms these sensory signals and integrates them into the entire virtual scene. Most virtual system output modules include touch sensor, 3D effect, 3D sound effect and 3D model database: 3D model data is a set of 3D models [4].

Input signals from the computer operator can be used to transform data into database by using storage in virtual world and various modules of virtual scenes to create new virtual data. Most of the development platforms for virtual software have been connected. The receiving module can be used to update the 3D database of virtual scene for users by signal input, user data, 3D model and signal output of users and, at the same time, the 3D scene can be adjusted for users to control signal output.



**Figure 1.** Component T of Virtual Reality System

When the system detects inputting commands, the sensor will operate in the virtual environment through the control module, and changes in the virtual environment are reported back to the user through output of the controlled sensor. Virtual environment is a modeling module that receives 3D data from various components of the real world and creates 3D models and data in various formats [5].

The virtual reality system is consisted of the following parts:

A. Machine interfaces, on the other hand, will take the user's suggestions which will be applied to the virtual environment because they provide instructions to the user after the operation is made. These human-computer interaction interfaces include: 3D head-mounted displays, stereo glasses and other visual displays, stereo audio displays and recognition devices. The position for interception and waiting depends on the purpose of the application program and the complexity of virtual system and interface device which was used.

B. High performance CPU professor, accelerated graphics components and projection HDR equipment are the basic hardware of virtual environment generator. Besides, real-time high-speed graphics data processing and data transmission are also the basic need of the machine.

C. A 3D digital data (3D data of the parts of the real world) consists of a corresponding virtual environment.

D. Computer Software are used to generate 3D data and 3D modeling of actual components, including Alias, ICEM, RTT, VRED models and actual display of virtual environments.

## 2 VRT And Traditional CAD

Both virtual reality and traditional computer aid design techniques are used with computer systems as a method for design and engineering, which is a little bit similar. However, there is a big difference between VRT and traditional CAD techniques. Traditional CAD is used to define product structure and virtual technology as interactive display methods by using computer modeling. Due to the particularity of this method, there are different specifications for all design and engineering methods for auditory and the design in auditory process [6], which is mainly divided into:

A. VRT has two important functions, that is, interaction and real-time rendering, which are not achieved by traditional CAD;

B. VRT provides methods to designers and engineer to be immersive review, while traditional CAD methods are passive observers;

C. In fact, the graphics of VRT are very powerful with a certain sense of distance and a sense of vertical distance, which are not achieved by original CAD;

D.VRT technology can be used to realize management for diversified product life cycle, development of new and old product and also resource sharing.

### **3 The Application of Virtual Reality Technology in Transportation Design**

According to the traditional methods of automotive design, the design and rationality in the process can be tested by virtual reality data for automotives from initial design and production, however, the model for design and simulation of real world can hardly be used ,which takes long time for computers to test the internal and external parts of the automotives.

#### **3.1 Virtual Design of Transportation Design**

To create a traditional full-size physical model of a car, the skeleton is built using wood or steel, the foam is used to cover the model, the surface is treated with sludge, and the desired color and trim (including the model) is painted. Simulating interior parts to summarize each physical model. To check whether the proportion of all cars is consistent with the visibility behavior and the full-size prototype model should be checked to determine whether the model has been formally created. If the exterior surface design by the virtual models is used in the production process, manpower and material resources can be greatly saved and a variety of styles with different colors will be created, which can be modified according to the virtual requirement. Modeling information can be applied directly to follow links such as body structure design and design wedge pump virtual software, which can also be used to design various internal and external components of cars, including IP, CONSOLE, Gear shift, DOOR TRIM, LAMP, WHEELS, SEATS, and HEADLINER. For internal use, these parts can be redesigned based on virtual review. The appearance of the car must be made to meet the requirements of safety standards, ergonomics, production technology, assembly and maintenance. The design process depends on engineering constraints, and computer aid design technology is overshadowed in system and service restriction of VR utilization[7].

#### **3.2 A Virtual Experiment in Transportation Design and Engineering**

Shape is a major factor affecting aerodynamics of a new designed car, and its shape is tested through wind tunnel testing. At present, major automotive companies use cars that are 1/4 size of real cars for tunnel testing. Because of the discrepancy between the hard models and the final products, errors will be caused between the test results and the actual results. If all the models are used, the cost and structure for building large high wind tunnels will be huge and complex, which is not impossible for the automotive companies? When designing a new car, a physical model that is commonly used in most methods must be developed for re-testing in wind tunnel.

The virtual wind tunnel created by the virtual system enables transportation designers to see large 3D ventilation holes and analyze the complex 3D characteristics of multi-dimensional eddy effects and turbulence [8].The designer in the airflow zone feels like he were standing in a wind tunnel, and its properties do not interfere with fluid movement, thus the understanding for the changing properties of the human body was greatly improved. At the same time, with the help of related interactive devices, designers can perform related experience and modification work on these virtual objects, as well as perform aesthetic and ergonomic evaluation with the purpose to improve different parts of the new designed car. The external appearance of the interior parts is in "free" state and the final model is approved and the production of complex prototypes is canceled. Besides, the CAD model of the car can be changed and updated in real time.

### **4 The Application Example of Virtual Reality Technology in Design of Automotive Modeling**

The emergence of virtual technology is conducive to improve the design and testing methods of traditional cars and to solve complex problems of display by mathematical model. Besides, virtual technology is advantageous in finding potential issues in the initial design stage and solutions can

be made for resolving the issues.

General Motors Corporation should be the first company in the global automotive industry to use virtual reality technology. There was a design system in the midland when a employee entered a virtual studio and placed it on a display wall, a three-dimensional image that was the same size with the real car in the 3D space could be seen. You can also sit in the seat observing the control panel, shift lever and various components to check the comfort of seats, which was the result for comfortable interior environment and lighting[9].

The car design center of Mercedes-Benz provided a group of virtual design environments, called the "Virtual reality Center", in which the designer can check the line, shape of the car and the smoothness of the surface[10]. German developer Tecmath had developed an ergonomic model called "Ramsis" that can be used to conduct analysis on the surface and aerodynamic performance of a car. The system can be used to assess ergonomics such as visibility and position in a cab. The comfort of the driver's arms and legs presents an ergonomic layout in the virtual environment [11]. We can figure out the position of one person moving from one place to another virtual people moving to different locations. The view and sitting position were selected to conduct the following research: Checking the relationship between the seat and surrounding objects, and the tilt of human body, whether the dashboard was in the best position for view, should be observed.

## Conclusion

The coverage of automotive industry, complexity of the technology and rapid change. The development of the automotive industry is achieved by using the virtual reality technology in an extensive manner in design, modeling, test, engineering analysis, virtual assembly and UE. At present, the major automotive manufacturers in China have some knowledge of 3D digital design, and the electronic information accumulated in digital development can directly applied in the virtual environment. All of these are good conditions for introducing virtual reality.

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