Research on Virtual Reality Technology based on Cloud Computing

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Abstract: Because of its limitations in hardware and content, virtual reality technology has been unable to enter the mainstream consumer market. With the development of cloud computing technology, it can provide strong support for the application of virtual reality technology in hardware and technology. This paper analyses the changes brought by cloud computing to virtual reality on the hardware and content level, which can better solve the performance, ease of use and compatibility of virtual reality software and hardware.

1. Introduction

Virtual Reality (VR) is a technology that presents the virtual environment and things within the scope of human vision and provides human and virtual world with a variety of ways to interact. Virtual reality environment and objects have been used in game programs for a long time, but their hardware platform has been limited to PC and game host, and the way of human-computer interaction is relatively simple. In 2016, as the first year of the development of new virtual reality technology, along with the development of smart phones and wearable devices, VR is also considered as the next generation computing platform after computers and smart phones. It is expected to reshape the existing electronic market and be favored by the major technology giants and capital institutions. At the same time, VR has some applications in games, education and industry. However, VR has high requirements for hardware, and the price of high-performance VR equipment has remained high. Secondly, VR has very high requirements for application content, and VR content needs to match the hardware perfectly. At the same time, it needs to give users a good sense of immersion. Thirdly, users have high requirements for VR equipment and content experience, and poor hardware equipment can easily lead to users' fatigue or even discomfort. So after several years of development, VR technology is still difficult to large-scale industrial applications, the practical application field is only focused on the game. The corresponding VR equipment, only a few have been recognized by the market, and the price is very high.

VR industry chain involves hardware, software, content, application and many other links. Technologically, it includes content display, real-time computing, content storage, human-computer interaction, artificial intelligence and so on. It can be said that it is the master of the next generation of information technology. With the approaching of 5G technology and the maturity of cloud computing technology, high-speed, low-latency network environment and strong computing power are expected to support the popularization of virtual reality industry.

2. VR Technology Based on Cloud Computing

2.1 Limitations of VR Equipment

In general, VR devices require very high performance in computing and graphics processing of their built-in hardware. The mainstream general VR devices nowadays have powerful built-in CPU and GPU to meet the real-time data computing requirements. Strong hardware leads to high cost of VR equipment. At the same time, VR equipment is often huge, amazing weight, high power consumption and calorific value is a common problem. Because of the power supply problem, the existing high-performance VR equipment can not be used porTable at all, and need external power supply. At the same time, due to the large size and high weight, users often face a huge burden when wearing these devices, which can not be worn for a long time, seriously affecting the user

experience and the health of users.

There have been some VR devices (even without power supply) which are very cheap, small in weight, easy to wear and can be used for a long time without external power supply. These devices seem good, but there is no built-in computing hardware at all. This means that it is impossible for such VR devices to compute and display content by themselves. External computing devices are needed to cooperate (e.g. smartphones, TV or movie screens). Therefore, such devices can not be called complete VR devices, but only a VR accessory. At the same time, this kind of VR accessory simply can not give users a complete VR vision, when displaying VR content, there will be a visual blind area, which can not bring users a real sense of immersion.

2.2 Limitations of VR Content Display

After VR content is made, it needs to be calculated in real time by VR device and displayed to users by corresponding display device. At the same time, VR devices are required to respond to the user's behavior and integrate these responses with the next VR content. This series of processes for users can not have any visual delay or unsmooth. Generally speaking, the frame rate of VR content should not be less than 90 frames per second to achieve perfect fluency. Even the most advanced VR equipment cannot guarantee a high frame rate in any VR content. With the passage of time, the hardware of user VR devices is fixed, and the quality of VR content will become higher and higher (for example, higher resolution, more complex light effect and texture, etc.). This will lead to the VR hardware cannot meet the content requirements, and ultimately, users have to buy new hardware to support new content, thus increasing the user's financial burden.

2.3 VR Technology Based on Cloud Computing

2.3.1 The Characteristics and Advantages of Cloud Computing

Cloud computing is a mature network computing mode based on Internet. Through virtualization technology, distributed parallel processing technology and online software services, cloud computing Abstracts computing, storage, network, platform and other infrastructure and information services into an operable and manageable super cloud resource pool, which dynamically provides users with software as a service. SaaS, Platform as a Service (PaaS), Infrastructure as a Service (IaaS), etc.

The characteristics of cloud computing can be summarized as follows:

1) Flexible service. The scale of services can be rapidly scaled to automatically adapt to dynamic changes in business load. The resources used by users are consistent with the business requirements, avoiding the degradation of service quality or waste of resources caused by server performance overload or redundancy.

2) Resource pooling. Resources are managed in a pool of shared resources. Using virtualization technology, resources are shared to different users, and the strategies of placement, management and allocation of resources are transparent to users.

3) On-demand service. It provides users with application, data storage, infrastructure and other resources in the form of services, and can automatically allocate resources according to users’ needs without the intervention of system administrators.

4) Service is billable. Monitor user's resource usage and charge service according to resource usage.

5) ubiquitous access. Users can access cloud computing services through the Internet anytime and anywhere using various terminal devices (such as PC, smart phones, sensors etc.).

Because of above characteristics, cloud computing can support almost any device to provide theoretical unlimited computing and storage capacity, while devices connected to the cloud can hardly need much computing and storage capacity, and it is easy to adapt different types of devices according to the content of the cloud..

2.3.2 VR devices based on Cloud Computing

The basic characteristic of cloud computing is that it has powerful computing power, can

complete all kinds of complex computing, but also can support and configure different computing scenarios. For example, besides virtual CPU (server) resources, cloud computing center can also provide GPU resources, Artificial Intelligence Computing resources, network security computing services resources, load balancing resources and so on. Because cloud computing uses virtual machine operation mode, it can configure the services provided and the hardware connected. For VR, first of all, cloud computing can replace computing hardware in VR devices, or can replace most of the computing hardware, thus concentrating computing power on the cloud, while VR devices are mainly responsible for display and user experience. The benefits are as follows:

1) Computing and generating content in the cloud without considering the inconsistency of VR device standards, which can solve the compatibility problem between content and VR devices. After the cloud is responsible for computing, the results are transmitted to the VR device, which can be further processed, such as dealing with the interaction between VR content and people, and then returning the processing results to the cloud for further calculation. Putting computing resources in the cloud and only outputting results to VR can reduce the compatibility between VR content and different VR devices.

2) To solve the problem of high hardware cost and waste of hardware resources: the main cost of VR equipment is the built-in computing hardware, which often has high performance and high price. However, as ordinary users, if not often using VR devices, these high-performance resources idle is a waste, as time changes, hardware performance cannot keep up with the new content requirements, which requires more money to replace hardware. Cloud computing is a pay-on-demand method, users need to pay when they use VR content, and there will be no cost if they do not use it. At the same time, the price of VR devices without built-in computing resources will also drop dramatically, and the cost of hardware replacement due to inadequate hardware performance will also be greatly reduced, because the main operations are done by the cloud.

3) Providing portability and long endurance: After reducing most computing resources, VR devices can dramatically reduce the demand for power, thus enabling long-term mobile use through built-in batteries. This is a very practical change, which can bring VR technology into more application scenarios. At the same time, smaller weight and smaller volume of VR devices are also conducive to users' long-term use, and enhance the user experience.

2.3.3 VR content based on Cloud Computing

Because of the characteristics of cloud computing itself, any device can access the cloud through high-speed network (which is a prerequisite). When the network speed is fast enough, VR content can be completely stored in the cloud. When users interact with VR devices, VR devices can send users 'requests back to the cloud. Through cloud computing, the adjusted content can be sent back to VR devices. This form of content presentation is especially suiTable for augmented reality (Augmented Reality) scenarios. Cloud can generate corresponding virtual scenes according to the actual scene, while VR only needs to show virtual objects to users.

The biggest obstacle to VR content placement in the cloud is that it can cause delays in VR content. If VR content wants to achieve the same user experience as the real environment, it cannot have any visual delay. However, there are more or less delay problems in the existing VR, mainly from two aspects. One is that the performance of VR equipment cannot meet the requirements of content, resulting in the unsTable frame rate of VR picture; the other is the unsmooth of picture caused by network delay. VR content based on cloud computing will not have the first problem, but the second one needs attention. With the popularization of 5G network and technology in the future, it is believed that the impact of network delay will be less and less.

2.3.4 Advantages of Cloud Computing in Data Acquisition and Data Analysis

The VR technology based on cloud computing has an additional advantage that it can obtain user data very well. When users interact with VR devices and VR content, various sensors of VR devices can collect users 'requests, feedback and other behaviors, and upload these data to the cloud (with the user's knowledge and permission), process and analyze them through the computing terminal of the cloud, and process the next VR content according to these data. This data input, collection and

processing is critical. On the one hand, these data can help service providers understand users' needs, experiences and operational problems, so as to better improve their products. On the other hand, these data are also the best training data set for service providers to develop AI services, and use user data to the AI part of VR environment. Training, and then improve VR content and VR services, enhance user experience.

3. Conclusion

VR technology based on cloud computing can solve some problems of existing VR technology, including the cost, performance, volume and weight of VR equipment, and can also bring more practical mobile experience for VR equipment. At the same time, VR content based on cloud computing can provide general content according to different VR devices, and solve the compatibility problem of VR content for different devices. Although cloud computing has many advantages in the future application of VR, an important prerequisite needs to be satisfied is to ensure absolute real-time transmission in the network transmission, without any delay, otherwise it will seriously affect the user experience. Looking forward to the future 5G technology can well solve the problem of wireless transmission.

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