An overview of augmented reality technology

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Abstract. Augmented reality is a technology that combines virtual reality with reality. In recent years, the rapid development of augmented reality technology has aroused people's high attention. This paper first expounds the research and progress of augmented reality at home and abroad. Secondly, it introduces the key technologies, development tools and application of augmented reality in some fields. Finally, it looks forward to the future development trend of augmented reality technologies such as AR cloud.

1. Introduction

Augmented Reality (AR) technology is a technology that combines virtual information with the real world. The technical means it uses include Multimedia, 3D-Modelling, Real-time Tracking and Registration, Intelligent Interaction, Sensing and more. Its principle is to apply computer-generated virtual information, such as text, images, 3D models, music, video, etc., to the real world after simulation. In this way, the two kinds of information complement each other, thus achieving the enhancement of the real world [1].

In recent years, more and more internationally renowned research institutions, universities and enterprises have invested in the research of AR, published lots of papers and scientific research results. These results demonstrate the feasibility and innovation of AR as human-computer interaction technology. With the improvement of computing power of computer software and hardware, AR has gradually shifted from the theoretical research stage of the laboratory to the stage of mass and industry application, and as a bridge between the digital world and the real world, it provides people with a new way to recognize and experience the things around. In addition, it has been listed as one of the top ten most promising technologies in the future by authoritative organizations such as the American Times Weekly [2]. In recent years, cloud computing has become a research hotspot in the Internet field. It can transfer storage and complex computing from the client to the cloud computing service environment, providing a possible distributed architecture pattern for complex interactive physical effects computing [3].

This paper summarizes the research status and progress of AR, discusses the key technologies, development tools, applications, AR cloud and other aspects of it, and finally puts forward the summary of the status quo and prospects for the future.

2. A Survey of The Research and Progress in Augmented Reality Technology

In recent years, there has been a strong atmosphere in the research of augmented reality technology at home and abroad. The number of relevant seminars is increasing. Academic journals and international

conferences provide researchers with a full space for communication. Its research focus from simple system framework, hardware tracking technology, to the current interactive performance evaluation.

At present, academic institutions engaged in augmented reality technology research include the University of North Carolina, Massachusetts Institute of Technology, Columbia University, Boeing company and SONY computer science laboratory. Foreign universities and research institutions that focus on AR technology generally focus on the algorithms, human-computer interaction methods, software and hardware infrastructure platforms in the core of technology. Among them, the well-known Human Interface Technology Lab of the University of Washington in Seattle, USA, supports the research ARToolKit open source project is the industry's first mature AR engine based on rectangular identification mark for 3D space registration [2]. There are few universities and research institutions involved in AR technology in China, such as the Institute of Optoelectronic Information Technology and Color Engineering, Beijing Institute of Technology, and the State Key Laboratory of Computer Aided Design and Graphics, Zhejiang University. The department of optics of Beijing institute of technology has studied the helmet display of augmented reality, and conducted a series of studies on 3d registration methods, lighting models and other issues. Shanghai university cooperated with Zhejiang university to study the real-time detection of light source and realistic rendering framework of AR scene [4]. From the papers published in China, the focus is on system application and registration technology. The research problems are relatively simple and the scope is relatively narrow.

2015 was the first year of AR, which has entered an irreversible explosion driven by capital and technology. Although AR technology has made great progress in the past 20 years, there are still many technical problems. Foreign AR hardware companies have Microsoft, Google, etc., and software includes Metaio, Vuforia, Wikitude, etc. Domestic related research is still in the laboratory stage, can be commercialized augmented reality products are very rare.

3. Key Technologies of Augmented Reality

Intelligent display technology, 3d registration technology and intelligent interaction technology constitute the core technology circle of AR and play an important role in the development of AR.

3.1. Intelligent display technology

According to relevant data, more than 65% of the information acquired by human beings comes from their own vision, which has become the most intuitive way for human beings to interact with the real environment. With the development of intelligent display technology, augmented reality becomes a possibility, which is pushed to a new height by the various kinds of display devices generated based on intelligent display technology. Specifically, there are three main categories of display devices that occupy an important position in the field of AR technology today. First, helmet display (HMD) was born in 1968. The optical perspective helmet display developed by professor Ivan Sutherland makes it possible to superimpose simple graphics constructed by computers on real scenes in real time. In the later development, optical perspective helmet-mounted display and video perspective helmet-mounted display constitute the backbone of helmet-mounted display. Second, handheld device display, relying on the augmented reality technology of handheld display, handheld device display is very light, small, especially the popularity of smart phones, through video perspective to the use of augmented reality technology to present. Third, other display devices, such as PC desktop displays, match the real-world scene information captured by the camera to a three-dimensional virtual model generated by the computer and are ultimately displayed by the desktop display.

3.2. 3D registration technology

As one of the most critical technologies in the augmented reality system, 3d registration technology enables virtual images to be superimposed accurately in the real environment. The main flow of 3d registration technology has two steps. First, determine the relationship between the virtual image, the model and the direction and position information of the camera or display device. Second, the virtual rendered image and model are accurately projected into the real environment, so the virtual image and

model can be merged with the real environment. There are various ways of 3d registration, such as the registration technology based on hardware tracker, the 3d registration technology based on computer vision, the 3d registration technology based on wireless network and the mixed registration technology, among which the former two are the most popular. For the three-dimensional registration technology based on computer vision, it sets the reference point to realize the determination of the direction and position of the real scene by the camera or the display.

3.3. Intelligent interaction technology

Intelligent interactive technology is closely related to intelligent display technology, 3d registration technology, ergonomics, cognitive psychology and other disciplines. In AR systems, there are a variety of intelligent interactions, including hardware device interactions, location interactions, tag-based or other information-based interactions. With the development of intelligent interaction technology, augmented reality not only superimposes virtual information to real scenes, but also realizes the interaction between people and virtual objects in real scenes. This interaction is based on the fact that people give specific instructions to the virtual object in the scene, and the virtual object can make some feedback, thus enabling the audience of the augmented reality application to achieve a better experience.

4. Augmented Reality Development Tools

4.1. Foreign AR SDK

ARKit is the AR development platform launched by Apple in 2017. Developers can use this suite of tools to create augmented reality applications for iPhones and iPads. ARKit helps developers develop AR applications that can support two devices to share the same virtual items, making the AR experience more interesting.

ARCore is Google's software platform for building AR applications, which is similar to Apple's ARKit. It can take advantage of advances in cloud software and device hardware to bring digital objects to the real world. The main functions are motion capture, environment perception and light source perception.

Vuforia is currently the most popular SDK. The main recognition function supports iOS, Android and UWP, and different SDKS are available according to different platforms. You can choose any one of Android Studio, Xcode, Visual Studio and Unity as a development tool according to your needs.

The Wikitude SDK reconstructs its propositions using the development framework of image recognition and tracking and geolocation technologies, including image recognition and tracking, 3D model rendering, video overlay, and location-based AR. In 2017, Wikitude rolled out SLAM technology (simultaneous localization and mapping) that enables object recognition and tracking, as well as unmarked real-time tracking.

4.2. Domestic AR SDK

The foreign AR SDK is not easy to meet the needs of domestic developers. The main difficulties include language communication barriers, poor technical support, slow technical support, and no results [5]. Domestic AR SDK has certain localization advantages. At present, the domestic AR SDK mainly includes Baidu AR, NetEase Insight AR, Vision+EasyAR, Liangfengtai HiAR, Tianyan AR, Taixu AR, and Magic AR.

On January 16, 2017, Baidu announced the official establishment of the augmented reality Lab (AR Lab). Baidu's DuMix AR 3.0 provides technology developers with innovative technical capabilities, including intelligent perception, virtual rendering, human-computer interaction, and efficient and flexible engineering development methods.

NetEase Insight AR such as client (AR content browser), Internet application engine (AR SDK) and AR game engine (AR GAME PLUGIN) can effectively connect high-quality AR content developers and usage scenarios to bring high quality to users.

EasyAR is a simple, easy to use and efficient SDK with desirable features and powerful functions that developers have been longing for a long time, including dynamic target recognition loading, H.264 hard decoding, recording screen function and local target recognition of more than 1000.

5. Application Areas of Augmented Reality Technology

AR technology has been applied in many fields, including tourism, archaeology, art, commerce, industrial manufacturing and restoration, education, emergency management, entertainment and leisure, and medical treatment.

In the field of tourism, the application of augmented reality technology to tourist attractions can restore historical sites by using mobile phone cameras, screen software and other technological means to integrate the real scenes. In addition to viewing scenes, additional information can be obtained.

AR technology is often used in archaeological studies to zoom in on relics in real landscapes to ensure that archaeologists can more accurately pinpoint their location.

AR technology allows consumers to see everything about a product without opening its packaging. By scanning the product picture, you can not only display some information of custom options, but also get other picture information of the product.

AR technology can guide workers visually, remind them of the time and draw in 3D to make products more efficiently. Take the automobile manufacturing industry as an example, AR technology can enable car designers to better improve the structure of cars and make better comparisons through visual presentation.

The application of AR technology in the field of art has enabled people to have more angles of experience and interpretation of reality. Often this fusion of reality and reality has become an art form.

AR technology can be used in public security solutions and has played a good role. For example, the augmented reality system for search and rescue is equipped with aerial camera, which can integrate the real scene with the forest road name and location identified by geography, so as to rescue the lost person more efficiently.

The doctor can use the AR technology to more accurately locate the patient's surgical site. The AR technology can better observe the fetus in real time. The AR technology can also remind the patient to take the medicine on time by letting the patient wear the relevant equipment.

6. AR Cloud

With a lot of early research into grid computing, cloud computing became possible. Cloud computing has become more and more popular since 2007. Cloud computing was one of Gartner's top ten IT industry strategic technologies in 2010. In the next few years, cloud computing will mature and become an important part of mainstream computing.

The AR cloud is the digitization of the entire world [6]. Charlie Fink proposed that with the emergence of AR cloud, the whole world will become a Shared space screen to realize the joint participation and collaboration between multiple users. The current AR experience is like a stand-alone game, requiring interconnection, collaboration, and sharing. The AR cloud is often seen as the evolution of search, and in the future a lot of people will be looking for surprises along the way in the AR world.

The implementation of AR cloud requires a real world 1:1 data set (building a data set consistent with the real world, including real-world position coordinate information, scene visual features, etc., and can be updated and expanded in real-time changes), need to quickly locate (the terminal device should be able to access this cloud in any place with network, and can quickly and accurately locate. Through the device's GPS, gyroscope, accelerometer, electronic compass, camera visual information, get point cloud and image upload go to the cloud, match the point cloud in the cloud, return location information), and also need interactive virtual content (the digital interactive content can be presented in any terminal, and can be updated in real time, and can also support between different devices Experience and interaction), also need to support multiplayer online interaction (supporting billions of users to create and experience AR information at any time, and to synchronize and share status in real time). In this way, the virtual world can have multiple versions, just like there are many game servers, users can

choose according to their own needs. In the basic physical and digital worlds, you can choose to access the AR cloud for different purposes (transportation, energy, health, social, entertainment, and so on).

However, the implementation of AR cloud needs to solve many problems, such as point cloud storage problem, network delay dropped line problem, user experience (UX) problem and so on. And some other key skills are not mature enough, the need for more natural and more intelligent voice interaction, need AI technology to deal with or is to generate huge data, need low latency 5 G networks need to block chain to inspire people to create and trade AR virtual content, need to the Internet of things let more information in the real world, and collaborative AR cloud.

7. Conclusion

In recent years, augmented reality technology has attracted extensive attention from researchers. Driven by computer vision and artificial intelligence technology, augmented reality technology has shown a strong momentum of development. Both the tracking registration accuracy, display equipment performance and the nature of human-computer interaction have been greatly improved. However, it can be seen that there are still many problems to be solved in augmented reality technology. In terms of tracking registration technology, the current tracking registration method can only make use of a small amount of information in the scene, such as feature point information, which leads to incomplete understanding of the system to the environment. In terms of display technology, the size and price of augmented reality glasses that can provide users with a high sense of submergence cannot meet the demand of the public. In terms of interaction mode, the more natural and multi-user augmented reality interaction technology remains to be studied.

In the next few years, the application of augmented reality technology, especially in the application of mobile intelligent terminals, will emerge in a large number. Although mobile devices are less submersible than helmet-mounted displays, they are highly popular. At the same time, the launch of ARKit and ARCore development platforms realizes the combination of augmented reality and smart mobile devices technically. In the future development, smart wearable devices, which can give full play to the advantages of augmented reality technology, will create a more realistic integration world for human beings. People can interact with the system in a more natural way of human-computer interaction. In the future, augmented reality technology will change human life to a great extent, which is an inevitable trend of scientific and technological development.

References

[1] Hu Tianyu et al., Overview of augmented reality technology. Computer Knowledge and Technology, 2017(34): 194-196(in Chinese).
[2] Wu Fan and Zhang Liang, An overview of the development and application of augmented reality technology. Computer Knowledge and Technology, 2012(34): 8319-8325(in Chinese).
[3] Zhou Zhong, Zhou Yi and Xiao Jiangjian, Overview of VR technology. Science in China: Information Science, 2015(02): 157-180(in Chinese).
[4] Quan Hongyan, Wang Changbo and Lin Junjun, Research review of vision-based augmented reality technology. Robotics, 2008(04): 379-384(in Chinese).
[5] Sightp, What are the good companies that domestic AR does. Website (https://m.elecfans.com/article/722890.html), 2018(04): 5-118(in Chinese).
[6] AR New Horizon, A little thought about and sharing about AR cloud. Website (https://zhuanlan.zhihu.com/p/44079215), 2018(09): 10-38(in Chinese).