Application Strategy of Panoramic Technology in Environmental Field Investigation

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Abstract: In order to improve the efficiency and quality of environmental field investigation, as well as realize real-time image data information sharing between the field environment and the investigation center, this paper first analyzes the application advantages of panoramic technology, followed by the types of panoramic technology, and finally takes the UAV panoramic technology as an example to demonstrate the application process of panoramic technology in environmental field investigation for the reference of relevant personnel.

Keywords: UAV panoramic technology; Environmental investigation; Sphere panorama

1. Introduction

The world we live in contains all kinds of information, such as color, shape, sound, and taste. Human beings are constantly evolving, perceiving and obtaining information through seeing, touching, hearing, and smelling. Among all the ways of perceiving the external world, the visual system accounts for 70% of the total amount of information, and it has become the most important way to obtain external information [1]. In today's digital age, images and videos have become the most intuitive and effective way for human beings to obtain information from the outside world. According to Cisco, by the end of this year, nearly one million minutes of video content per second will flow through the network, increasing the proportion of global IP video traffic to 82% of all private internet traffic [2]. However, with the increasing needs of users, the limitations of traditional image and video data are becoming more apparent. The limitations of the existing image and video data are mainly reflected in two aspects. First, traditional image and video data cannot provide users with a panoramic view [3], and their acquisitions are limited by the site environment, which hinders the integrity of the comprehensive description of the site environment. Second, the traditional image and video acquisition methods cannot provide users with a free-viewing experience. When viewing images and video information, users do not have sufficient interaction with the on-site environment.

2. Benefits of applying panoramic technology
2.1. A real 3D viewing experience

With binocular parallax [4], when observing the real world, the human eye can accurately gauge the actual distance and position relationship between objects in the scene, thus producing a three-dimensional viewing experience. Depending on the viewpoint selected by the user in panoramic application, combined with the head-mounted display (HMD) device, the image or video data of two channels with specific parallax are

sent to the left and right eyes of the user, respectively, which will then stimulate binocular parallax. It can reconstruct the real scene and the user's brain, as well as provide users with 3D immersive viewing experience.

2.2. Whole-scene viewing by selecting a single viewpoint
In panoramic application, the sender collects the entire scene information, and the receiver reconstructs the real scene and presents the entire scene to the user. Following that, users can freely choose the viewing position and angle in the scene. While watching, they can freely switch according to their preferences and explore details everywhere. Therefore, panoramic application breaks the restriction that users can passively view content from a specific place in traditional 2D applications, thus allowing users to freely view the scene from any position and angle they wish [5].

2.3. Scenario interaction
In addition to viewing scene information from any location, panoramic application also allows users to interact with the scene using gestures, voice, and other interactive methods. In the interaction process, users can perform various actions, such as switching viewpoint, controlling playback progress, and zooming in the scene. At the same time, panoramic application provides timely feedback based on the user's operation. In that way, panoramic application provides users with means to interact with objects in the scene, so that users can freely control objects in the scene and interact with virtual scenes. It enhances users' immersive viewing experience.

Compared with existing 2D applications, panoramic applications have attracted wide attention from academia and industry with the aforementioned advantages. Accordingly, panoramic monitoring, three-dimensional scene reconstruction, panoramic viewing, and other panoramic applications are also being introduced in succession. Therefore, panoramic application has gradually become the mainstream form of visual information display. However, in practical applications, panoramic applications not only provide users with immersive viewing experience, but also bring new challenges and difficulties to the existing compressed transmission system. First, compared with the fixed-point sampling mode of 2D applications, full sampling of the scene requires simultaneous sampling of various positions and angles of the scene at a specific time point to obtain image and video data that can perfectly represent the scene, which provides users with the freedom to view stereoscopic images and videos from any perspective. Second, compared with 2D applications, the data transmission speed and channel of panoramic technology provide users with a better observation experience. Panoramic technology has efficient coding technology, a large amount of storage space, and a fast transmission environment, which provides users with a good environment for viewing. Third, compared with the viewing method of 2D applications, panoramic technology can realize on-site interaction with users, has higher freedom, and can provide users with high-quality and immersive viewing experience [6-10].

3. Types of panoramic technology
3.1. Cylindrical panorama
Cylindrical panorama is the simplest virtual panorama, which has a 360-degree horizontal (or larger angle) view. For simulation-generating workstations, computer screens are used as windows for users to observe the virtual environment. By dragging the mouse left and right in the horizontal direction, the user can observe the left and right landscapes. However, if the user drags the mouse up and down, the visibility is limited. If it is empty, the viewer will not be able to see below or above. Cylindrical panorama can be taken with an ordinary camera. At present, many smartphones are equipped with panorama mode. When turning the phone's camera, a small slider appears on the screen, and the slider can be moved to make changes.

Users should ensure that the phone is kept horizontal and stable, while minimizing vertical offset. Otherwise, the panoramic picture will display a connection error. The small slider will end the progress; users may click the shutter button to end the shooting at any time, and the camera will then automatically produce the panoramic picture. At present, the built-in panoramic mode of most mobile phones in the market allows users to take panoramic photos of more than 180 degrees. Many mobile phones can also take photos of 240 degrees or 270 degrees. With the installation of certain software, it can also support 360-degree shooting, that is, "draw a circle." However, the panoramic shooting of mobile phones has a certain test on the stability of handheld shooting [11].

Therefore, environmental investigators often use ordinary photos for synthesis and splicing to obtain high-quality panoramic photos, in which a series of conventionally sized photos are taken clockwise or counterclockwise. Users should pay attention to the boundary overlap of adjacent photos, and then use image processing software to adjust the brightness, contrast, hue, sharpness, and other elements. After taking photos, users can import the photos into the static panorama creation software. They can insert, delete, move, rotate, and rearrange the photos as needed. Finally, these photos as panorama photos or web pages can be saved for use.

3.2. Spherical panorama

Spherical panorama, which has 360 degrees horizontal and 180 degrees vertical viewing, allows for a more realistic virtual scene experience. When used in a closed scene, the sound system is completely invisible; hence, users need to monitor it with their eyes. Using the world's hearing in a computer-generated environment gives users a fully-engaged, immersive feeling.

The production of spherical panorama is more professional. First, two photos need to be taken with a professional fisheye lens, and then a spherical panorama is produced by using a professional software. At present, China has made remarkable achievements in this field of expertise. For instance, China Haida's iSCAN series, with multiple fisheye HD cameras equipped in on-site acquisition equipment, can realize material shooting and data processing. The panoramic mosaic software HD Pano factory provides full functions, such as data detection, panoramic output, output detection, panoramic PS processing, and algorithm-based thumbnail generation. In addition, this set of equipment and software utilizes the GPS positioning system to collect point clouds and models, slice pictures, and create street scenes; the continuous shooting function of the HD camera can produce continuous panoramic pictures to complete roaming. HD MapCloud RealVision software is reliable. In addition to more professional spherical shooting, ordinary mobile phones can also complete shooting through software. For example, Google camera has a photo sphere mode. There is a "ball" and a "big blue dot" in the middle of mobile phones to guide users to gradually capture the spherical panorama. These are the photos required for photo splicing. For this 360-degree panoramic shooting software, Google suggests that when taking spherical panoramic photos, the mobile phone should be close to the face to improve the synthesis rate, while avoiding close shooting and maintaining posture. It is necessary to keep away from crowds during shooting to avoid ghosting. However, in the actual work process, the software naturally splices multiple pictures, so it is very important to ensure the angle of the mobile phone during the shooting process [12-14].

3.3. Cube panorama

Cube panoramic technology is another splicing technology to realize panoramic view. It defies the existing splicing technology of single spherical panorama, in which it splices panoramas with higher accuracy and storage efficiency. Cube panorama is mainly used to build an indoor virtual environment. For example, the simulation of model houses by real estate developers. Customers can fully view the three-dimensional structure and design of various model houses by sitting in front of the computer and dragging the mouse.

If users wish to have a more immersive experience, they can use the CAVE virtual reality system and the rectangular projection image collaborative environment based on multi-channel image synchronization technology and stereo display technology, so as to fully immerse themselves in the closed advanced virtual simulation environment. With the interactive experience from the corresponding virtual reality interactive equipment, users can obtain immersive high-resolution 3D stereo audio-visual images and six degrees of freedom.

The production of cube panoramic photos is a complicated process. First of all, all pictures should be taken when taking photos, but for ordinary digital cameras, a lot of photos need to be taken (finally combined into 6 photos).

They are then spliced together using a special software, such as Pano7cd, to create a panoramic image expanded into a cube. Ordinary mobile phones can also complete cube shooting through Google camera and other software. In the "panorama" mode, there is a cube shooting mode, and the "big blue dot" is used to guide users through the process of capturing the frames needed for photo splicing. The perspective of the photos shot in this mode is strong, but the direction of the photos must be high; otherwise, the close-up photos will be prone to perspective distortion.

3.4. Object panorama

The panoramic view of the subject is different from the panoramic view of the scenery. The camera must be facing the subject directly when shooting, and one of the two shooting methods – equatorial mountain or environment – is used. In other words, the tripod rotates around the central axis of the subject, takes a picture around the subject, and then uses the object panoramic mosaic and playback software to create and explore the object panoramic picture. Object panoramic technology is mainly used in commercial fields, such as the automobile industry. It produces 3D panoramic automobile models through web pages, allowing users to visually view and purchase automobiles. However, in recent years, object panoramic technology has also been used to safeguard cultural heritage digitally, such as in the 3D reconstruction or reproduction of cultural assets in conjunction with 3D modeling technology, allowing cultural assets to be separated from regional restrictions and resources. The sharing of these cultural assets can be realized through the internet [15].

The 3D laser scanning technology is used to create a rough point cloud model of the object, and the image data acquisition technology is used to create the details displayed through the texture material, resulting in a more realistic panorama of the object. An image processing software (such as Photoshop) can then be used to perform necessary operations on the photos, such as cutting, splicing, deformation, and sharpening; finally, a 3D modeling software (such as 3ds Max) can be used to complete, map, and illuminate.

4. Application process of UAV panoramic technology

UAV panoramic technology is a type of panoramic technology. UAV panoramic technology is taken as an example to highlight the application of panoramic technology. In order to enable technicians to employ UAV panoramic technology to complete the image modelling task, all departments involved in field environmental investigation should focus on improving themselves and fulfilling their individual tasks.

4.1. Panoramic image acquisition

When applying the UAV panoramic technology, technicians should pay attention to image acquisition. By reasonably setting the UAV, the accuracy of the collected image data can be assured. Generally, technicians attach great importance to the collection and sorting of existing data, as well as strive to obtain high-resolution image data to meet the information collection tasks for various purposes. For image acquisition, it is necessary to select appropriate UAV types according to different scenes. Common UAVs are divided

into fixed wing, large rotor, and small rotor. Technicians must reasonably select technical equipment for use to complete various tasks according to the investigation needs of the actual environment. During the operation, technicians must combine the data transmitted by the UAV to realize effective monitoring of the project.

4.2. Panoramic image creation

Panoramic images can reflect real-time scenarios of the site environment and facilitate easier viewing for the investigators and other relevant personnel. The UAV panoramic technology allows operators to fully exploit the benefits of the obtained image data, complete the production of panoramic images, improve the definition of the overall projection, and ensure the smooth transition between existing images. Technicians collect and process data to create panoramic images as well as capture and monitor the images of the surrounding environment through the UAV camera technology, so as to create a set of panoramic images of the site environment in the control center. In the application of this technology, some images often overlap. In order to further improve the overall work quality, technicians need to strengthen the representation and recognition of the same image and complete the creation of panoramic images. Only by precision work can we ensure that the panoramic images are clean and complete, and that they meet the requirements of environmental field operations.

4.3. Panoramic image navigation

Panoramic image navigation enables users to better understand and view the site environment. The development of panoramic image navigation relies heavily on panoramic images. For panoramic picture navigation, technicians must select appropriate panoramic images, apply the UAV panoramic technology more effectively, and improve the quality of environmental field investigation. Users can select spherical panoramic images and configure the panoramic image navigation based on the site conditions and their own demands. They can click to view all the images according to some of the displayed image information. In practical application, technical personnel must formulate scientific and reasonable countermeasures based on the site conditions to meet the needs of users. Since panoramic images contain a large amount of data, technical personnel must formulate appropriate response mechanisms to realize the whole process environmental investigation control and adapt to the needs of the current on-site environmental investigation business, in order to maximize the overall environmental investigation quality.

5. Conclusion

In conclusion, panoramic technology enables users to engage in a real 3D viewing experience, select a scene to view it in entirety, and conduct on-site interactions. In the application of panoramic technology in environmental field investigation, panoramic images must first be collected and then created, and finally, image navigation is perfomed to form a complete on-site environment image.

Disclosure statement

The authors declare no conflict of interest.

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