



Seamless and Fast Panoramic Image Generation System Based on VR Technology

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Abstract. In view of the design of seamless and fast panoramic image generation system, the traditional panoramic image generation system has the problems of poor image generation effect and long calculation time. The design of seamless and fast panoramic image generation system based on VR technology is proposed. According to the image edge processing mechanism, the hardware structure of the system is designed, and the software function of the image processor in the hardware is designed. The process of image edge recognition is described in detail, and the edge is tracked and refined to accurately track the direction and offset of the pixel. The boundary pixel information is recorded by VR technology, and the seamless system of panoramic image is realized by combining the corresponding image data. The experimental results show that the highest generation effect of the system is 90%, which shortens the calculation time and provides effective support for the research of automatic image generation system.

Keywords: VR Technology · Panoramic image · Seamless · Generate

1 Introduction

VR technology has been involved in video conference, network technology and distributed computing technology, and developed to distributed virtual reality. Virtual reality technology has become an important means of new product design and development. In the VR environment for collaborative design, team members can synchronously or asynchronously construct and operate virtual objects in the virtual environment, and evaluate, discuss and redesign virtual objects [1]. The general image reflects the local scene, while the panoramic image reflects the global scene. It has a wide range of application prospects in security monitoring, virtual tourism, education and entertainment, and military fields. There are two kinds of panoramic images: spherical panoramic image and cylindrical panoramic image. Among them, the spherical panorama can reflect the scene in any direction in the space, but it is difficult to deal with it; the cylindrical panorama does not have two parts of the scene: the top cover and the bottom cover, which limits the viewing angle of the user in the vertical

direction, but the water square is 360° , which can meet the needs of most applications. Cylindrical panorama is much simpler than spherical panorama, so it is more widely used [2]. Traditional panoramic image generation system has some problems, such as slow speed, low efficiency, and poor image automatic generation effect. For example, in the financial field, the profit drawing is often inaccurate, and the dynamic digital image cannot be edge recognized, resulting in poor image display effect, and algorithm takes a long time [3].

In order to overcome these shortcomings, a seamless and fast panoramic image generation system based on VR technology is proposed. Using the system, the shortcomings of the traditional system image generation method can be overcome without splicing, and the rapid generation of panoramic images can be realized by taking one image.

2 Design of Seamless and Fast Generation System of Panoramic Image

2.1 System Hardware Design

The hardware design of panoramic image automatic generation system is to provide a dynamic expansion mode for the digital under the relevant network service program. According to the requirements of the demander, the large-scale panoramic image is distributed. The hardware design diagram of the system is shown in Fig. 1.

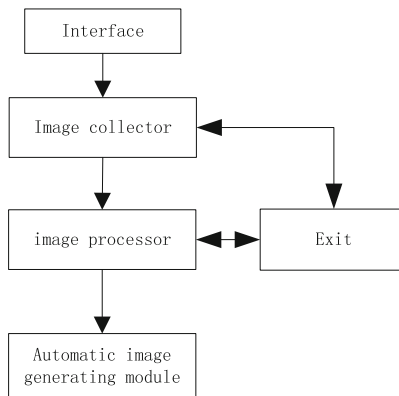


Fig. 1. System hardware design block diagram

It can be seen from Fig. 1 that the design of the image collector is mainly to transmit the collected data from the network interface to the large-scale panoramic image processor, and then transmit it to the top of the single-chip microcomputer for adjustment through the pin of the single-chip microcomputer. When the information and pin transmission of MCU are finished, it is necessary to communicate with other MCU to provide the foundation for image processor. The image processor mainly

processes the collected image, and processes the collected image data with the image thread with high sharing efficiency, which can also be realized by programming [4–6]. The automatic image generation module uses a single-chip microcomputer to complete the automatic storage of data, and converts the data into images through the built-in structure, and automatically generates a panoramic image through software program operation [7].

2.2 Function Design of System Software

Aiming at the image processor in the system hardware, the software function is designed. After computer processing, the pattern can be automatically recognized, then we use virtual reality technology to track and refine the image edge [8].

2.2.1 Edge Recognition

In the panoramic image based on VR technology, edge refers to the set of pixels whose gray values $I(x, y, t)$ of surrounding pixels have periodical changes, and the edge recognition method is to recognize the pattern edge obtained by the pattern corrosion and expansion operation. The specific steps are as follows:

- (1) Treat structural element (x, y) as a template which is designed to examine the image structure, and its size is generally smaller than the normal image, the calculation formula is:

$$\Delta I(x, y) = \{I(x, y, t + 1) - I(x, y, t)\} \quad (1)$$

Where, $\Delta I(x, y)$ represents the pixel gray difference between time $t + 1$ and time t of the pixel gray value of the frame video image.

- (2) Corrosion is to shrink the edge of the image to the interior, and its function is to clear the boundary action points T , so that the external expansion becomes more expansive, whose expression is:

$$I(x, y) = \begin{cases} 1 & \Delta I(x, y) > T \\ 0 & \Delta I(x, y) \leq T \end{cases} \quad (2)$$

In order to be able to identify the image contour clearly, it is necessary to define an image as a structural element, select a binary image according to the defined structural element, and use the most accurate positioning method for edge positioning [9].

2.2.2 Image Edge Tracking and Thinning

Image edge tracking and thinning is to process and extract the recognized image edge, so as to obtain the edge with a width greater than 1 pixel. In order to track the image edge accurately, the width needs to be set as 1 pixel. In order to solve the tracking problem, it is necessary to find out the boundary pixels of the target image strictly in order to record the corresponding coordinates. According to the edge width of 1 pixel

standard, analyze the pixel positions in 8 different fields, and accurately track the direction and offset of the pixel [10–13].

The specific tracking process is as follows:

- (1) Scan the top left part of the panoramic image from left to right [14–16], from top to bottom to obtain the first edge point j of the target image, whose expression is:

$$j = \min\{j/d(I_i, I(x, y))\} \leq \theta_1 \quad (3)$$

Where, θ_1 represents the maximum distance threshold between two pixel points in the video image of the subsequent frame; I_i represents the non-zero pixel in the video image, and d represents the spatial dimension.

- (2) Assuming that the initial search direction is the lower left corner, this point is taken as the pixel boundary point I_{mean} , and then the coordinates of the boundary point are recorded, set as the background color, and marked as the current coordinates, whose expression is:

$$VR = \sum_{i=1}^m (I_i - I_{mean})^2 j \quad (4)$$

- (3) Turn the lower left corner of the search direction 90° clockwise to find the subsequent edge points; if the search fails, turn the original search direction 45° counterclockwise to find the subsequent edge points; if no new edge points appear, then there is no new edge point in the range [17].
- (4) Repeat until the background color of the entire panoramic image is set.

2.2.3 Automatic Generation

The image information used in the seamless and fast generation system of panoramic image based on VR technology must be real-time. Its structure is that the boundary pixel information recorded is:

```
typedef struct TEdgePoint{
short int X;      //Row of image pixels;
    short int Y;      //Column of image pixels;
    short int Type;    //Boundary point species;
};
```

For the boundary sampling point, the image edge samples are collected mainly according to the set working time. A seamless and fast panoramic image generation system is designed by processing image information according to schematic diagram.

3 Experiment

In order to verify the rationality of the design of the seamless and rapid panoramic image generation system based on VR technology, the dynamic data of a city's financial trading company is taken as an example.

3.1 Experimental Environment and Parameter Setting

The specific parameter settings are shown in Table 1.

Table 1. Parameter settings

Parameter	Numerical value
Data acquisition floating range	-20-35 dB
Maximum number of overlaps	100 dB
Data collection channel	10 species
Computer data processing power	140 Hz
Image resolution ratio	18 bits
Computer image display resolution	15 bits

3.2 Experimental Condition Setting

Set up several employees of financial trading company to upload data at the same time and record the speed change in time, as shown in Table 2.

Table 2. Changes in the rate of generation

Number of uploads	Generation speed (KB/s)
1	656.22
5	655.13
10	705.12
20	712.16
50	732.13

From Table 2, it can be seen that the automatic generation speed of the system when one company's employees upload data is not much different from that when five, 10, 20 and 50 employees upload data.

3.3 Experimental Results and Analysis

Based on the parameter setting in Table 1 and the change of generation speed in Table 2, the system designed based on VR technology is compared with the seamless

and fast generation speed of panoramic image of traditional system, and the specific comparison is as follows.

3.3.1 Co Channel Interference

The same frequency interference refers to the overlapping part of different monitors, and its field strength is the sum of the signal field strength from each monitor. Because of the different signal propagation path, propagation medium and transmission equipment, the signal sent by each monitor is not consistent with the theoretical signal time. It shows that there is delay error between each signal, and then the relative phase difference of each signal is produced. Because of the phase difference, the signals in each overlapping area are interfered by the same frequency, which directly affects the normal monitoring of the system. The system designed with VR technology will not be affected by the same frequency interference, while the traditional system will be affected by the same frequency interference, resulting in poor generation effect. In order to verify this point, the two systems are compared, and the results are shown in Fig. 2.

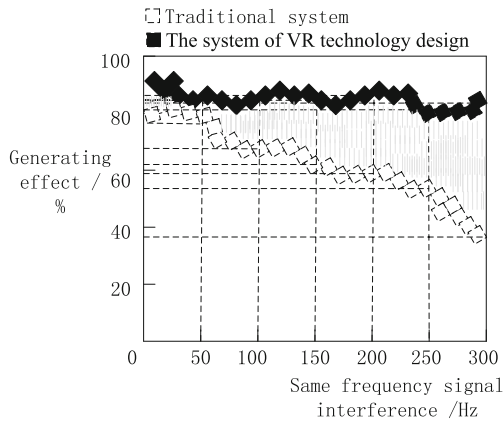


Fig. 2. Comparison of the generation effects of the two systems under the same frequency interference

It can be seen from Fig. 2 that when the intensity of the same frequency interference signal is 50 Hz, the generation effect of the traditional system is 78%, and the generation effect of the system designed based on VR technology is 82%; When the same frequency interference signal strength is 100 Hz, the traditional system generation effect is 70%, and the system generation effect based on VR technology is 81%; When the same frequency interference signal strength is 150 Hz, the traditional system generation effect is 59%, and the system generation effect based on VR technology is 80%; When the same frequency interference signal strength is 200 Hz, the traditional system generation effect is 59%, and the system generation effect based on VR technology is 90%; When the same frequency interference signal strength is 250 Hz, the traditional system generation effect is 54%, and the system generation effect based on VR technology is 79%; When the same frequency interference signal strength is

300 Hz, the traditional system generation effect is 39%, and the system generation effect based on VR technology is 81%. According to the comparison results, under the same frequency interference, the generation effect of the system designed based on VR technology is better than that of the traditional system.

3.3.2 The Influence of Human Factors

In order to illustrate that the system designed based on VR technology has better effect on panoramic image generation than the traditional system, the two systems need to be compared and analyzed, and the results are shown in Fig. 3.

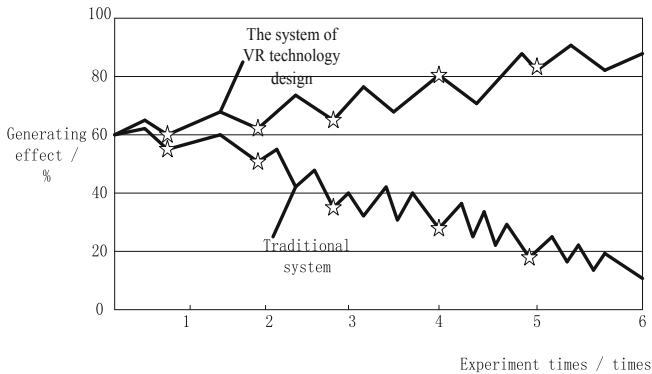


Fig. 3. Path identification of different methods

It can be seen from Fig. 3 that the initial generation effect of the two systems is 60%, when the number of experiments is 1, the generation effect of the traditional system is 58%, and the generation effect of the seamless generation system designed based on VR technology is 63%; When the number of experiments is 2, the generation effect of traditional system is 50%, and the generation effect of seamless generation system based on VR technology is 70%; When the number of experiments is 3, the generation effect of traditional system is 38%, and the generation effect of seamless generation system based on VR technology is 72%; When the number of experiments is 4, the generation effect of traditional system is 30%, and the generation effect of seamless generation system based on VR technology is 80%; When the number of experiments is 5, the generation effect of traditional system is 21%, and the generation effect of seamless generation system based on VR technology is 82%; When the number of experiments is 6, the generation effect of traditional system is 10%, and the generation effect of seamless generation system based on VR technology is 89%. The results show that under the influence of human factors, the system generation effect based on virtual reality technology is better than the traditional system generation effect.

3.3.3 Calculation Complexity

In order to further verify the effectiveness of the system in this paper, take the calculation time of the algorithm as the experimental index, and compare the calculation complexity of the system in this paper and the traditional system. The comparison results are shown in Fig. 4.

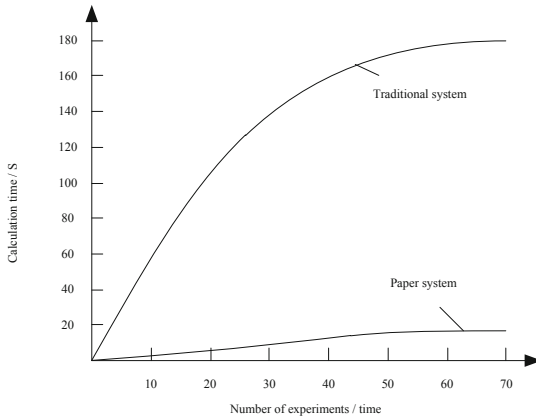


Fig. 4. Calculation time comparison of two systems

According to Fig. 4, when the number of experiments is 50, the algorithm calculation time of this system presents a stable state, when the number of experiments is 70, the calculation time is 16S; while the algorithm calculation time of the traditional method shows an upward trend, when the number of experiments is 70, the calculation time is 180 s. The algorithm calculation time of this system is shorter than that of the traditional system, which shows the calculation time of this system The computational complexity is low.

3.4 Experimental Conclusion

According to the above experimental contents, the experimental conclusion can be drawn:

- ① Same frequency interference: when the same frequency interference signal strength is 50 Hz, the system generation effect designed based on VR technology is 4% higher than that of traditional system; when the same frequency interference signal strength is 100 Hz, the system generation effect designed based on VR technology is 11% higher than that of traditional system; when the same frequency interference signal strength is 150 Hz, the system generation effect designed based on VR technology is higher than that of traditional system When the same frequency interference signal strength is 200 Hz, the generation effect of the system designed based on VR technology is 31% higher than that of the traditional system; when the same frequency interference signal strength is 250 Hz, the

generation effect of the system designed based on VR technology is 25% higher than that of the traditional system; when the same frequency interference signal strength is 300 Hz, the generation effect of the system designed based on VR technology is 25% higher than that of the traditional system. The formation effect is 42% higher. Therefore, under the same frequency interference, the system based on VR technology has a better generation effect.

- ② Influence of human factors: when the number of experiments is 1, 2, 3, 4, 5 and 6 respectively, the generation effect of VR based system is 5%, 20%, 34%, 50%, 61%, 79% and 79% higher than that of traditional system. Therefore, under the influence of human factors, the system based on VR technology is better.
- ③ Calculation complexity: when the number of experiments is 70, the calculation time of the algorithm of system application designed based on VR technology is 16S, while that of traditional system application is 180 s. Therefore, the calculation complexity of the system in this paper is low and the calculation time is short.

To sum up: Based on VR technology panoramic image seamless fast generation system is reasonable.

4 Concluding Remarks

The seamless and fast generation system of panoramic image based on VR technology is designed, but there is no deep research on other problems. Without a comprehensive analysis on the image interface problem, the probability of interference cannot be determined. Many methods are needed to solve the unknown parameters.

In the more complex network environment, in order to meet the flexibility and reliability requirements of panoramic image automatic generation, it is necessary to use more advanced control equipment to collect image data to ensure the research reliability of the rapid generation system, so as to realize the seamless rapid generation system of panoramic image widely used.

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