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Research on Software Display Technology of Shipborne Radar Terminal

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Abstract. Based on the whole integrated computing system, processing of radar video data based on network, how to realize the terminal display of shipborne has become an important research direction, and the displaying of effect has become a key factor to measure the quality of the equipments. In view of the windows multimedia's instructions, the developments of DirectX3D and OpenGL language, the paper uses three different ways to achieve the display and the attenuation . The effect is great.

Keywords: shipborne, attenuation, pipelines, etc.

1. Introduction

With the development of Shipborne integrated computing environment,the unified management and processing of all kinds of shipborne radar and sensors's data has became the future direction of the development of modern naval equipments. In this context, the front-end sensor data acquisition after receiving data sent them to the network, different terminal systems for processing and displaying become the implementation of a simple and effective, and based on the local computation unit implementation and traditional hardware in the same way as the display of radar display terminal technology is difficult to achieve. Radar image is formed by quantizing the echo signal and displaying [1] according to amplitude information. Afterglow is the realization of the attenuation of radar image's brightness according to certain rule. Using local computing devices, this paper first processes radar data from the network, and then uses the spatial attenuation method and the mixed attenuation method to achieve the display of radar images and afterglow, which meets the requirements of radar terminal software display.

2. Data Processing

The radar video data is digitalized through the front devices and sends it to the network. Trough we receive and process the data from network and display,the display of shipborne radar terminal need to process in a certain way. In order to realize the follow-up processing of the radar video processing module, the data receiving module sets up the data sharing area and writes the received data into the shared area. The data sharing area is used to store the radar video data. As a buffer, the asynchronous radar video image display can be realized,which is showed in Figure 1.

In order to display the radars' video,we should get the shared data area first,then read the data from he shared data area.Thirdly, according to different directions we realize the transformation of rectangular coordinates to polar coordinates and write the transformed data in the share cache. At the same time with processing, according to the different directions and the different data in the share cache,we should do the fusion of the data of display's cache and the scan lines' cached and form a display image to display of outputting. The process shows in Figure 2. When the radar video data swept a range, and then according to

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the set of decay control parameters, so that the radar video data pixel density of the sector decreased gradually, many times after writing, the radar video image pixel density in the sector will reach 0, so as to realize the radar video image displaying with decaying.

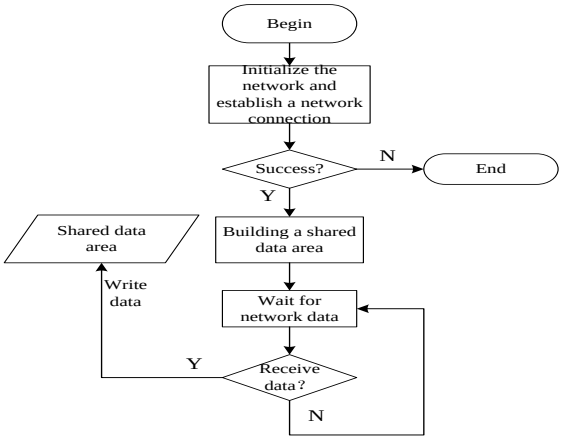

Fig. 1: The module of Data with receiving and processing.

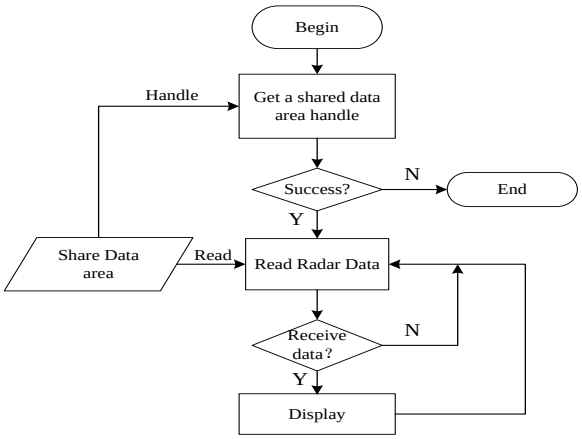

Fig. 2: The chart of radar video processing.

3. Methods of Realization

3.1. Space Attenuation Method

Radar video images occupy a contiguous address space in memory, in order to realize the spatial attenuation[2], we must design a continuous algorithm from the address space of the video memory to find suitable random pixels, so that it becomes the background color.The key space attenuation method is: in the rewriting of the radar video image pixels, the frame memory address sequence must be irregular, pseudo random number sequence uniformly distributed, the cycle length should be equal to the frame memory capacity.For example,Frame memory capacity image is 1024x1024, namely the pixel address is 220, for a refresh cycle so that the total pixel gray attenuation, produced 220 integers in a pseudo-random number sequence period, the range of 0 ~ 219, and the order is random and uniform distribution.The congruence method can satisfy as follows:

$$Xn+1 = \lambda Xn+C \ (\text{mod } M) \tag{1}$$

Mod M represents the operation result of $\lambda Xn+C$. The remainder of the modulo M is the value of the Xn+1. In binary systems, M = 2L, formula (1) produces the maximum possible period of pseudo random numbers T = 2L. The sequence of Xn can take long period, should take the parameters according to the following method: $\lambda = 4Q+1$, C = 2A1, X0 for any non negative integer. Among them, L, Q and A take positive integers.

Theoretical analysis and statistical tests show that the numerical series of ideal statistical properties can not be generated when the value of λ is too small or 0 or 1 of its binary form is regularly arranged. On the contrary, it is generally advisable. The method of changing the values of λ and C to observe the decay effect of afterglow will be used to determine their optimum values.

Space attenuation technology integrated display technology is the use of Windows multimedia functions to achieve the display of radar video image based on the technology in the afterglow of implementation, the use of pseudo random numbers uniformly distributed pumping display.Its display is shown in Figure 3.

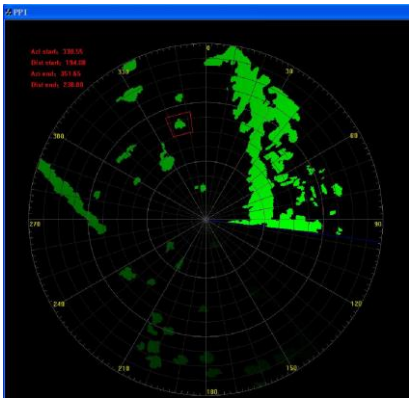

Fig. 3: The display of radar based on GDI's method.

3.2. Hybrid Attenuation Method

With the development of third party graphics software, the real-time high-speed processing of radar video images can be realized. There are two developments of graphics card,which are DirectX 3D [2]and OpenGL[3]. DirectX 3D is an application interface,which csn get the higher execution efficiency, strengthen the effect of 3D graphics base on the platform of windows. Meanwhile,It can reduce the complexity of the user's installation and setup of the hardware using a common hardware driver standard to different drivers for different brands.OpenGL(Open Graphics Library) defines a professional graphic program interface for cross programming languages and cross platform programming interface specifications. It is a powerful, easily invoked underlying graphics library to process 3D images.

Both of them can not only operate the graphics card through the card driver, but also provide various display interface functions and display functions for the operating system and various applications,and the realization has the following steps: first, rendering 3D object technology to realize the display of radar terminal, then using Alpha mixing technology to realize radar afterglow attenuation. Third party development package can depend on the processing ability of graphics, occupy host less resources and can be extracted for subsequent target track, target tracking and save more computing space and time, meet the overall requirements of radar.

The software display technology includes two aspects, one is rendering 3D objects, and the other is using the Alpha mixing technology to realize radar video afterglow attenuation.The process of rendering 3D objects is divided into two stages. The first one is called coordinate transformation and and Lighting (T&L), and the second stage is called rasterization (Transforming and Lighting T&L). The specific relationship is shown in Figure 4.

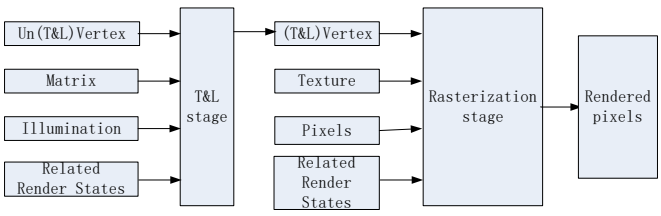

Fig. 4: The two stages of rendering the 3D object.

The T&L pipeline passes through a series of transformations, as shown in Figure 5.

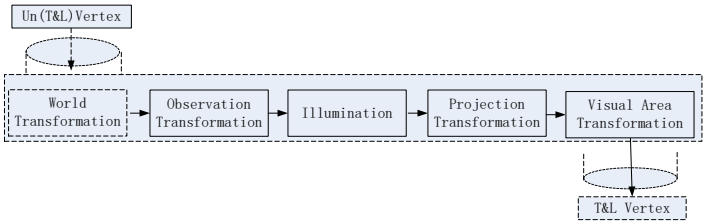

Fig. 5: T&L pipelining.

In order to draw a transparent object, by defining a representation of an object semi transparent Alpha value and a transparent formula[4], can combine the existing color and buffer color will be drawn , and then draw the objects with translucent effect, the calculation method is as follows:

$$Color = (RGB_{src} \cdot K_{src}) OP (RGB_{dst} \cdot K_{dst}) \quad (2)$$

In Color Alpha said the mixed color value; RGB_{src} is source color value, is about to draw a primitive color value, K_{src} is mixing coefficient of source, usually assigned to represent the object translucent degree of Alpha value; RGB_{dst} is target color values, namely the color buffer color value, K_{dst} is target mixing coefficient ; OP is the hybrid method with the calculation results of source and the color buffer, which belongs to the enumeration values.

DirectX 3D and OpenGL will accelerate the multimedia program and run in the hardware abstraction layer, realize the processing and display of radar video image.The method can use the hardware characteristics of GPU(Graphics Processing Unit), the operation effect is higher.The effect shows in Figure 6.

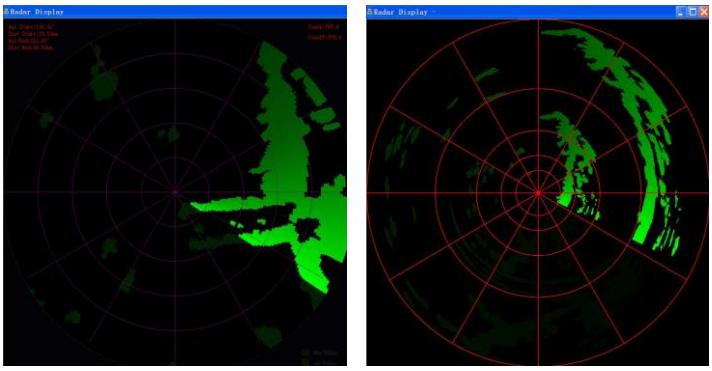

Fig. 6: The display of radar based on DirectX 3D and OpenGL.

From the above research it can make the analysis in Table 1.

Table 1: The differences of the three methods

Methods	Advantages	Disadvantages
Display technique based on spatial attenuation	high efficiency of drawing	a stronger particle size when the attenuation is large
Display technology based on texture blending of DirectX 3D	using the characteristic of hardware GPU	It only supports the Window's system; It is lumpy when the attenuation is large
Display technology based on OpenGL texture blending	When attenuation is large, the effect is ideal	It needs at least OpenGL2.0; the CPU occupancy is higher

4. Conclusion

Terminal software display is a developing trend of shipborne radar equipment. It not only shows lower cost, but also is flexible in signal processing and manipulation. The three methods above can be implemented. The hybrid attenuation method can make good use of the powerful processing power of the video card, and can share more processing tasks for hoster. Therefore, the radar terminal display based on the hybrid attenuation method will be the first choice. Treatment methods of current CPU occupancy rate is high, the main data processing takes more time, we can use the HLSL or GLSL (Programmable pipeline Shader Language) [6]on GPU vertex shader's file and fragment shader's file, send the data to GPU memory using GPU processing in the future and the resource occupancy rate will be decline.

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5. References

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