

Research Article

Virtual Viewpoint Film and Television Synthesis Based on the Intelligent Algorithm of Wireless Network Communication for Image Repair

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With the development of the computer vision field, the acquisition of scene depth information is one of the important topics in the three-dimensional reconstruction of the computer vision field, and its significance is particularly important. The purpose of this paper is to study the virtual viewpoint video synthesis for image restoration based on the intelligent algorithm of wireless network communication. Aiming at the hole problem caused by the change of occlusion relationship, this paper proposes a hole-filling method based on background recognition. A threshold segmentation algorithm is used to reduce the filling priority of foreground pixels at the boundary of the hole and fully solve the hole problem. This paper also proposes a wireless sensor network node positioning model with swarm intelligence algorithm, which combines swarm intelligence algorithm with some key issues of wireless sensor network, speeds up the convergence, and improves the traditional intelligence algorithm. According to the experimental data in this paper, the algorithm in this paper is about 20% higher than the traditional algorithm in PSNR. On SSIM, the performance of the algorithm in this paper is 4.6% higher than the traditional algorithm at most, and the lowest is 2.2%.

1. Introduction

1.1. Background Significance and Innovation. In recent years, with the widespread promotion of free-viewpoint video, in addition to focusing on the quality of each frame of image restoration, the problem of time continuity in image sequences has also received a lot of attention. The use of real texture information in the time direction is far more important than the use of real texture information in the time direction. The texture information repaired on the image is important. At present, domestic scholars seldom pay attention to the time continuity of virtual viewpoint video, and most of them still stay in the spatial domain. As a key technology in modern society, wireless sensor network plays an irreplaceable role in modern society and has gradually become one of the important research fields at home and abroad. Node positioning is a very important technology in wireless sensor networks. It supports the realization of topology, routing, and area coverage. Accurate node location

information is very important and necessary. In many cases, data without location is lost. Some characteristics of the wireless sensor network itself can also be reflected in the positioning of some nodes.

As the most important part of obtaining parallax in binocular and multieye stereo vision systems, virtual viewpoint is the core of passive depth acquisition technology. In recent years, it has always been the key research object of domestic and foreign scholars, and it has also become binocular and multieye stereo vision. Due to its simple principle, no need for encoding and decoding, and low requirements for scenes and camera hardware, virtual viewpoint has attracted attention in terms of depth acquisition. In recent years, its research has gradually increased, and its application fields have become more extensive. The field, people's daily life, and other aspects are playing more and more important roles. As the application range of wireless sensor networks continues to increase, new research topics continue to emerge. How to achieve effective and reliable node

positioning is the cornerstone of wireless sensor network applications. It is related to key issues such as routing, topology, and coverage. The realization of this will drive progress and development in other areas. If accurate node positioning is achieved, it will speed up the research progress of various aspects of sensor networks and broaden its application fields, which is of far-reaching significance.

In the wireless network communication image restoration, the research of image denoising problem is also worthy of people's thinking. In spatial domain filtering, the most classic denoising methods for image denoising include maximum filtering, mean filtering, and Wiener filtering. A common feature of these spatial domain methods is to perform the same operation on all pixels of the entire image. This will also cause them to be unable to effectively remove specific noise, and at the same time, the denoising effect is often lower than the expected result. In order to solve the shortcomings of spatial filtering, people use frequency domain methods for image denoising, which can transform the image into the frequency domain after being transformed in the spatial domain. Therefore, the image information is divided into two parts, high frequency and low frequency, and the noise exists in the high frequency part. The image is processed in the frequency domain; this way can effectively retain a large amount of information in the original image without being destroyed. However, this method cannot effectively remove the noise if the noise is coincident with the image and there is no obvious separation.

Sparse representation has also been successfully applied to image denoising. If this sparse denoising method wants to achieve the ideal denoising result, it needs a better sparsity transformation method, that is, it needs a small amount of sparseness to get the main features of the original data. In addition, nonlocal self-similarity and BM3D have excellent image denoising effects. They have better performance, especially for regular and repetitive texture images. However, nonlocal self-similarity often requires specific features for denoising. Secondly, nonlocal self-similarity models are usually nonconvex and involve multiple manually selected parameters.

The purpose of this article is to (1) solve the problem of wireless network communication obstacles, while ensuring the safety of the wireless network; (2) in view of the gradual development of image restoration to automation, the removal of text, objects, etc., in images, videos, etc., has been developed from the original restoration of scratches and stains; (3) explore the results of wireless network communication in image denoising.

The innovations of this paper are as follows: (1) Aiming at the problem of a large number of holes in a single viewpoint, the sample-based image restoration algorithm improves the data items. (2) Aiming at the hole problem caused by the change of the occlusion relationship, a hole-filling method based on background recognition is proposed. (3) The performance of the hybrid algorithm of quantum particle swarm optimization and harmony search is studied, and its simulation verification is carried out, and it is applied to the localization of wireless sensor network nodes.

1.2. Related Work. Wali et al. consider the structure and motion estimation problems in multiview teleconference-type sequences and their application in video sequence compression and intermediate view generation. A method for estimating structure from stereo pairs, a novel image alignment method, and a multiview sequence encoder are proposed [1]. Wang et al. considered the structure and motion estimation problems in stereo teleconference-type sequence and its application in stereo sequence compression and intermediate view generation. By extracting foreground objects and studying the relationship between the left and right images, the redundancy of the left and right image pairs is used to compress the image pairs, and at the same time, virtual viewpoints are generated between the left and right image pairs [2]. Fei et al. believe that the virtual screening method has become an adaptive response to a large number of throughput synthesis and screening techniques. Based on the structural permeation paradigm, he discussed three possible virtual screening schemes for optimizing binding affinity and pharmacokinetic properties [3]. Kosuke et al. believe that Kinect is a motion-sensing camera released by Microsoft for generating depth and color images. Since Kinect uses infrared mode, it will create holes and noise around the boundaries of objects in the acquired image. There will also be flickering and mismatched edges. They proposed a real-time virtual view video synthesis algorithm, which solves these problems to generate high-quality virtual views [4]. Li et al. proposed a user model for the subjective quality evaluation of virtual viewpoint images (VVI) of free viewpoint video systems. VVI is rendered by adjacent-viewpoint color and depth images. It is a new type of image generated for human-computer interaction (HCI) in a free-viewpoint video system. In this system, the natural scene is captured by a multiview camera, and the user can watch the scene from any desired perspective, whether it is real or virtual [5]. According to Huszák and Háló, the image processing apparatus according to the embodiment includes an image acquisition unit, an information acquisition unit, a generation unit, a synthesis unit, a determination unit, and a display control unit. The generating unit generates a virtual viewpoint image that views the environment of the vehicle from the virtual viewpoint based on the captured image. The synthesizing unit synthesizes the notification image that provides notification of the presence of an obstacle at the detected position with the virtual viewpoint image. The display control unit controls the display format of the notification image synthesized with the virtual viewpoint image based on the position information [6]. Huszák and Háló propose a new stereo matching algorithm for the void and false contour problems in virtual view rendering technology, which completes virtual view synthesis by obtaining dense disparity maps. Through cross-checking to filter false matching points and occluded parts, the multipoint virtual view drawing is completed. Salwe and Naik proposed a VHO mechanism that uses images as dynamic discrete data for transmission and a switching mechanism based on received signal strength (RSS). The novelty of the work lies

in the image data used for the simulation, the RSS calculation using the free-space propagation model, the reception delay calculation, and the sample-based time series analysis of the received data. The results show that when the VHO mechanism is implemented in devices operating in the ISM band, it provides a seamless connection between different communication protocols [7]. Cho et al. proposed a new 3D image transmission method using in-network computing (INC) for overall imaging. In integral imaging, the information of the 3D object can be recorded as multiple 2D basic images with different viewing angles, so that the amount of data sent is very large. Therefore, the transmission efficiency of 3D images via wireless networks is very low. In order to improve this transmission efficiency, we determined the correlation between the basic images and reduced the amount of data transmitted by the INC, which allowed the intermediate nodes in the network to compress the relevant images before transmission. Experimental results show that this method will not significantly reduce the visual quality of 3D images, but it can significantly reduce the amount of transmitted data [8]. Wang et al. proposed an energy-saving image compression transmission scheme, which can provide low-complexity region of interest extraction, energy-driven image quality control, and robust image communication against packet loss in wireless camera networks. The performance of the proposed scheme is studied in terms of image quality, execution time, and energy consumption. In addition, the proposed scheme is verified on the actual deployed camera sensor nodes, and the test results show that the method is reliable and feasible for resource-constrained wireless camera networks [9]. Islam et al. proposed a new robust solution to minimize the limitations of traditional wireless networks. The program uses a software-defined image sensor network (SD-ISN) to ensure the scalability and reliability of the sensor network to deal with data loss. Finally, in the simulation, the proposed SD-ISN and traditional wireless networks are compared to test the robustness and effectiveness of the proposed SD-ISN method [10]. Zhan et al. have developed a novel cost aggregation, including guided images, fast aggregation functions, and simplified scan line optimization. Experiments show that compared with the latest aggregation method on 32 Middlebury stereo data sets, the proposed algorithm is competitive in terms of accuracy and speed [11]. Tung and Gündüz introduced a hybrid digital-analog wireless image transmission scheme called SparseCast, which provides an elegant degradation of channel quality. SparseCast utilizes frequency domain sparsity through compressed sensing to improve end-to-end reconstruction quality while reducing bandwidth requirements. The proposed algorithm produces a linear relationship between the channel signal-to-noise ratio (CSNR) and the peak signal-to-noise ratio (PSNR) without requiring knowledge of the transmitter's channel state. SparseCast has benchmarked two alternative algorithms: SoftCast and BCS-SPL. The research results show that the proposed algorithm is about 3.1 dB better than SoftCast and 14.8 dB better than BCS-SPL [12].

2. Method of Virtual Viewpoint Film and Television Synthesis for Image Restoration Based on Intelligent Algorithm of Wireless Network Communication

2.1. Development of Intelligent Algorithms. The advantages of swarm intelligence are mainly reflected in the following aspects: no centralized control, individual withdrawal or failure, can not affect the solution of the entire problem, and has more powerful robustness [13]. Groups are self-organizing, and the performance of particle swarm optimization algorithms is particularly outstanding. Simple particles exhibit complex group intelligence behaviors through cooperation. There are no special requirements for the continuity of the problem definition, which can solve not only continuous optimization problems but also discrete optimization problems. Each individual in the group is not isolated and can change the environment through the change of its own information, and the system has relatively strong scalability [14].

From Table 1, it is a research on the status quo of a swarm intelligence algorithm. The swarm intelligence algorithm is based on the behavior of social creatures, modeling and reconstructing this model [15]. The collective foraging process of ant colonies and bird colonies reflects the limited ability of individual individuals, but the group can complete complex tasks through cooperation and division of labor. The process of optimizing the goal based on group behavior reflects the mutual cooperation and sharing of information between individuals to achieve the optimal goal. It is suitable for solving optimization problems and reflects the good solving characteristics of the algorithm. It proves that it has powerful abilities and unparalleled advantages, and it has a good development prospect in the rapid development of modern society [16].

As a new evolutionary computing technology, swarm intelligence algorithm has become the focus of more and more researchers. It has a very special connection with artificial life, especially evolution strategy and genetic algorithm. There are two main algorithms in the research field of swarm intelligence theory: ant colony algorithm and particle swarm optimization algorithm. Ant colony algorithm is a simulation of the food collection process of ant colony, and it has been successfully applied to many discrete optimization problems. The particle swarm optimization algorithm also originated from the simulation of simple social systems. At first, it was to simulate the process of flocks of birds foraging, but it was later found to be a good optimization tool.

The particle swarm optimization algorithm is an evolutionary computing technology, which originated from the study of bird predation behavior. Ant colony algorithm is a kind of swarm intelligence algorithm. It is a group of unintelligent or slightly intelligent individuals that show intelligent behavior through mutual cooperation, thus providing a new possibility for solving complex problems. Cultural algorithm is a two-layer evolution mechanism. Culture serves as a knowledge base in which people's past experience is stored, so that future generations can learn experience knowledge that they have not directly experienced in the

TABLE 1: The dynamics of swarm intelligent robots.

Algorithm name	Simulation	Target
Particle swarm optimization algorithm (PSO)	Flock of birds	Find a habitat
Ant colony algorithm (ACO)	Ant colony	Look for food
Cultural algorithm (CA)	Humanity	Knowledge and cultural progress
Artificial fish school algorithm (AFSA)	Fishes	Group life behavior

knowledge base. The artificial fish school algorithm is to simulate the foraging behavior of fish schools. The algorithm has good ability to solve the global optimal solution, low requirements for initial values and parameters, strong robustness, and easy operation. It has been widely used in many fields.

Particle swarm algorithm process: (1) initialization: initialize the particle swarm (the particle swarm has n particles in total), and assign a random initial position and speed to each particle; (2) calculate the fitness value: calculate the fitness value of each particle according to the fitness function; (3) find the best fitness value of the individual: for each particle, compare the fitness value of its current position with the fitness value corresponding to the best position in history, if the fitness value of the current position is higher, the current position is used to update the historical best position; (4) find the best fitness value of the group: for each particle, compare the fitness value of its current position with the fitness value corresponding to the global best position. If the fitness value of the current position is higher, update the global best position with the current position; (5) update particle position and speed: update the speed and position of each particle according to the formula; (6) determine whether the algorithm is over: if the end condition is not met, return to step 2; if the end condition is met, the algorithm ends; and the global best position is the global optimal solution.

The process of ant colony algorithm: (1) initialize relevant parameters, including ant initialization colony size, pheromone factor, heuristic function factor, pheromone, volatilization factor, pheromone constant, and maximum number of iterations, and read the data into the program, and perform basic processing on the data, such as converting the coordinate position of the city into a matrix between cities. (2) Randomly place ants at different starting points, and calculate the next city to visit for each ant until the updated pheromone table has ants visited all cities. (3) Calculate the path length (formula) that each ant passes, record the optimal solution in the current iteration number, and update the pheromone concentration on the connecting path of each city. (4) Determine whether the maximum number of iterations is reached, if not, return to step 2; otherwise, terminate the program. (5) Output the program results, and output the relevant indicators in the process of program optimization, such as running time and number of convergence iterations, as needed.

2.2. Architecture of the Wireless Network

2.2.1. Network Structure. As shown in Figure 1, it is the network structure of the wireless network. A typical sensor net-

work consists of collection nodes, communication nodes, transmission networks, and management nodes. There are a large number of sensor nodes in the monitoring area, which are used to sense, collect, and monitor information in the designated area, and then use a certain route to transmit to the collection node, and then through the Internet or satellite media, through wireless transmission, and finally reach the upper computer of the monitoring system. Each sensor node must not only have the ability to connect to each other and communicate and locate but also complete the task of collecting and forwarding data [17].

2.2.2. Node Physical Structure. As shown in Figure 2, it is the physical composition of the wireless sensor network node. The sensor node is the basic functional unit of the wireless sensor network and the core of the network. The communication unit is composed of a communication data transceiver to complete wireless communication with other nodes; the energy supply is composed of a power supply, which provides the required electrical energy for the entire node [18]. The size and mass of the nodes are relatively small, and the batteries carried can only provide limited power supply. In the node design, based on the principle of energy saving and maximum life, long-life batteries and low-power devices should be used [19].

2.3. Camera Marking Algorithm. The depth image obtained after the depth data is preprocessed uses the depth image coordinate system, which is a two-dimensional rectangular coordinate system u - v in pixels; $q(u', v')$ represents the u' row in the depth image, the pixel in the v' column.

$$\begin{cases} x_q = \frac{d_q(u_q - u_0)}{f_u}, \\ y_q = \frac{d_q(v_q - v_0)}{f_v}, \\ z_q = D(Q). \end{cases} \quad (1)$$

$D(Q)$ is the depth value corresponding to point Q , and (u_0, v_0) is the corresponding position of the center of the infrared camera in the depth image coordinate system.

$$D(q) \begin{bmatrix} u \\ v \\ 1 \end{bmatrix} = \begin{bmatrix} g_u & 0 & u_0 \\ 0 & g_v & v_0 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} x_q \\ y_q \\ z_q \\ 1 \end{bmatrix}. \quad (2)$$

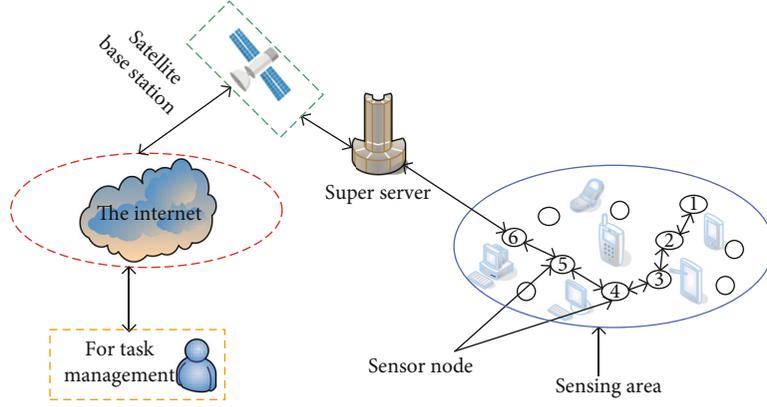


FIGURE 1: The network structure of the wireless network.

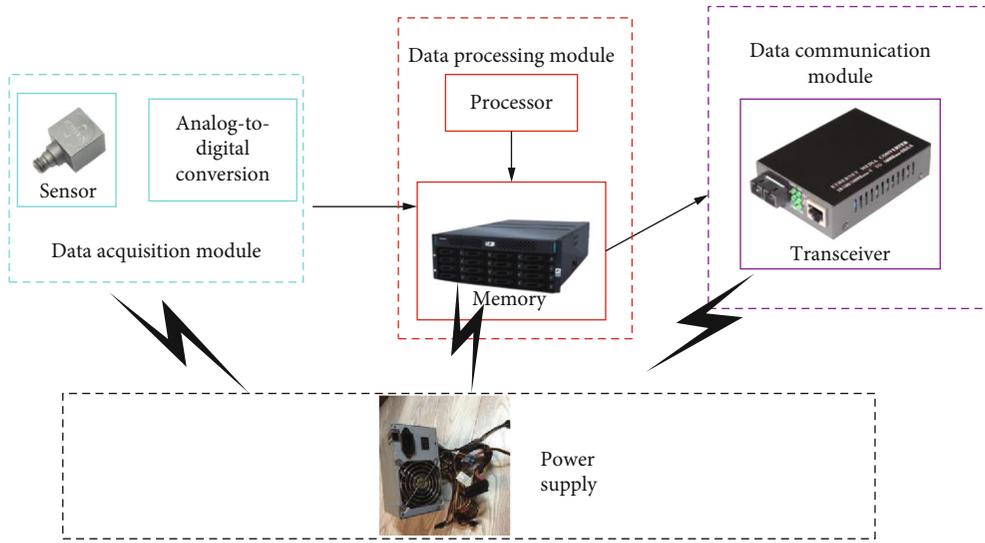


FIGURE 2: Node physical composition.

Among them, let

$$K_d = \begin{bmatrix} g_u & 0 & u_0 \\ 0 & g_v & v_0 \\ 0 & 0 & 1 \end{bmatrix}. \quad (3)$$

Then, the matrix K_d is the internal parameter matrix of the infrared camera, and it also has

$$D(q) \begin{bmatrix} u \\ v \\ 1 \end{bmatrix} = K_d \begin{bmatrix} x_q \\ y_q \\ z_q \\ 1 \end{bmatrix}. \quad (4)$$

Next, you need to map the coordinates in the camera coordinate space to the coordinates in the world coordinate

space. The formula is as follows:

$$\begin{bmatrix} X_q \\ Y_q \\ z_q \\ 1 \end{bmatrix} = \begin{bmatrix} R_i & t_i \\ 0^T & 1 \end{bmatrix} \begin{bmatrix} X_q \\ Y_q \\ z_q \\ 1 \end{bmatrix}. \quad (5)$$

The matrix R_i is a 3×3 rotation matrix. Make

$$M_i = \begin{bmatrix} R_i & t_i \\ 0^T & 1 \end{bmatrix}. \quad (6)$$

Then, the matrix M_i is the external parameter matrix of the camera at time i .

Combining the above formulas, the formula for mapping depth information to the world coordinate space can be

obtained:

$$D(Q) \begin{bmatrix} u \\ v \\ 1 \end{bmatrix} = \begin{bmatrix} g_u & 0 & u_0 \\ 0 & g_v & v_0 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} R_i & t_i \\ 0^T & 1 \end{bmatrix} \begin{bmatrix} X_q \\ Y_q \\ Z_q \\ 1 \end{bmatrix} = K_d M_i \begin{bmatrix} X_q \\ Y_q \\ Z_q \\ 1 \end{bmatrix}. \quad (7)$$

The calibration template is a plane, so it is assumed that the Z value in the world coordinate system is always 0, and the formula of substituting $Z=0$ into the point in the two-dimensional space to the coordinates in the three-dimensional world coordinate system can be obtained:

$$D(Q) \begin{bmatrix} u \\ v \\ 1 \end{bmatrix} = \begin{bmatrix} g_u & 0 & u_0 \\ 0 & g_v & v_0 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} R_i & t_i \\ 0^T & 1 \end{bmatrix} \begin{bmatrix} X_q \\ Y_q \\ 0 \\ 1 \end{bmatrix}. \quad (8)$$

Then, there are

$$\begin{bmatrix} u \\ v \\ 1 \end{bmatrix} = \frac{K \begin{bmatrix} r_{xi} & r_{yi} & r \end{bmatrix}}{D(Q)} \begin{bmatrix} X_p \\ Y_p \\ 1 \end{bmatrix} = H \begin{bmatrix} X_p \\ Y_p \\ 1 \end{bmatrix}. \quad (9)$$

Where K is the camera internal parameter matrix, let

$$H = \frac{K \begin{bmatrix} r_{xi} & r_{yi} & r \end{bmatrix}}{D(Q)} \begin{bmatrix} X_p \\ Y_p \\ 1 \end{bmatrix}. \quad (10)$$

Then, there are

$$\begin{bmatrix} u \\ v \\ 1 \end{bmatrix} = H \begin{bmatrix} X_p \\ Y_p \\ 1 \end{bmatrix}. \quad (11)$$

Decompose H into column vector form, let

$$\begin{aligned} r_{xi} &= d_p K^{-1} h_1, \\ r_{yi} &= d_p K^{-1} h_2. \end{aligned} \quad (12)$$

Then, there are

$$H = [h_1 \quad h_2 \quad h_3]^T. \quad (13)$$

Among them, r_{xi} and r_{yi} represent the rotation coefficient. Since the X axis and the Y axis are perpendicular to

each other, there are

$$\begin{cases} r_{xi} r_{yi}^T = h_1 K^{-1} K^{-T} h_2^T = 0, \\ \|r_{xi}\| = \|r_{xi}\|^2 = r_{xi} r_{xi}^T = h_1 K^{-1} K^{-T} h_1^T = 1, \\ \|r_{yi}\| = \|r_{yi}\|^2 = r_{yi} r_{yi}^T = h_2 K^{-1} K^{-T} h_2^T = 1. \end{cases} \quad (14)$$

Order again:

$$N = K^{-1} K^{-T} = \begin{bmatrix} N_{11} & N_{12} & N_{13} \\ N_{21} & N_{22} & N_{23} \\ N_{31} & N_{32} & N_{33} \end{bmatrix}. \quad (15)$$

Obviously, the matrix N is a standard symmetric matrix, so the 6-dimensional vector n can be set as

$$n = [N_{11} \quad N_{12} \quad N_{22} \quad N_{13} \quad N_{23} \quad N_{33}]. \quad (16)$$

Let the column vector of matrix H be

$$h_i = [h_{i1} \quad h_{i2} \quad h_{i3}]^T. \quad (17)$$

According to the orthogonality,

$$h_i^T N h_j = l_{ij}^T n \quad (18)$$

in

$$l_{ij} = [h_{i1} h_{j1}, h_{i1} h_{j2} + h_{i2} h_{j1}, h_{i2} h_{j2}, h_{i3} h_{j1} + h_{i1} h_{j3}, h_{i3} h_{j2} + h_{i2} h_{j3}, h_{i3} h_{j3}]^T. \quad (19)$$

And then get

$$\begin{bmatrix} l_{12}^T \\ (l_{11} - l_{12})^T \end{bmatrix} m = L m = 0. \quad (20)$$

It can be seen that the final matrix L is a 2×6 matrix, so at least 3 samples are needed to obtain the required matrix H , and then, the internal parameter matrix K and the external parameter matrix M can be solved.

2.4. Stereo Matching Algorithm in Depth Image Acquisition.

Stereo matching is a hot research field in computer vision technology, and it is an important step for virtual viewpoint rendering and 3D reconstruction. In the process of shooting, the objects in the three-dimensional world are projected onto the two-dimensional plane, losing the original geometric information [20]. In order to restore the real three-dimensional scene information, it is necessary to establish the matching key of the objects in the two images with the help of stereo matching, determine the coordinates of the objects in the three-dimensional space according to the basic geometric principles of the camera, and draw the depth map [21]. Due to the morbidity of the stereo matching problem, especially in the weak texture area, the edge of the object with discontinuous depth, and the occluded area, the effect

of the stereo matching still needs to be improved [22]. As shown in Figure 3, it is the flow chart of the virtual viewpoint synthesis algorithm based on image restoration.

Stereo matching is an important research field for obtaining image depth in computer vision [23]. The core purpose of stereo matching is to obtain the corresponding relationship of the pixels in the image taken by the same scene from different viewpoints, and through this correspondence, the disparity map of the photographed scene can be found, and the obtained disparity map is the study of the subsequent depth map [24]. But in actual operation, we will find that there are many problems that affect the accuracy of stereo matching, such as deformation, occlusion, and mismatch of regions. In the current research, the main stereo matching algorithms used are the region-based stereo matching algorithm and feature-based stereo matching algorithm. Dense estimation of stereo disparity is an important part of computer vision applications. However, the feature-based disparity estimation technology only calculates the disparity with a few known feature points, so it cannot estimate the image well [25]. In this paper, an image segmentation method based on an improved genetic algorithm and feature matching technology as the core method are proposed to achieve dense estimation of stereo disparity.

2.5. Difficulties of Virtual Viewpoint Images

2.5.1. Hole Problem. The area of the tiny cavity is very small, showing the size of one to two pixels. There are three main reasons for its formation: first, the image size of the object is different due to the change of the viewpoint position [26]. The same object, because it is viewed at different viewpoint positions, the size of the object displayed on the imaging plane of the viewpoint is not the same, and there may be compression or expansion of the image size of the object. The imaging size of the object has changed, but the sampling rate of the reference image remains unchanged, so small holes will appear on the imaging plane of the virtual viewpoint. The second is the inaccuracy of the depth map. Due to the slight difference in the depth values of objects in the same depth plane, when 3DWarping is mapped to the virtual viewpoint imaging plane, there will be errors in the pixel positions of the mapping, resulting in small holes a few pixels wide [27]. The third is the rounding processing of the mapped pixel coordinates. When projecting to the virtual viewpoint imaging plane through the 3DWarping mapping equation, the mapped pixel coordinates are not necessarily integers, and the position coordinates of the pixels on the image are integer values. There is a process of rounding the decimal coordinates to integer coordinates, so there will be small holes formed by rounding errors of coordinates [28].

For example, due to the conversion of viewpoint positions, the image of the scene seen from one viewpoint is different from the image seen from other viewpoints, just as our eyes see different scenes. Because of the objective occlusion relationship between objects, the background pixels occluded by foreground objects in the reference viewpoint image cannot be mapped to the virtual viewpoint image

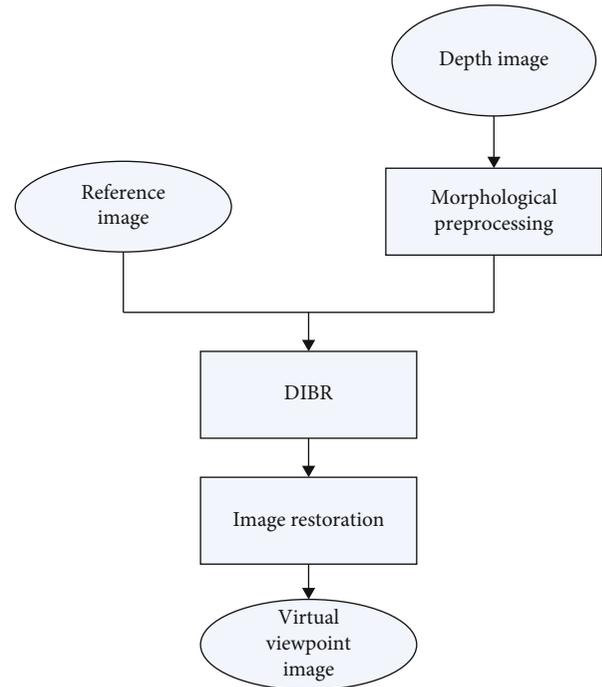


FIGURE 3: Flow chart of virtual viewpoint synthesis algorithm based on image restoration.

[29], so a relatively large area of holes will be formed in the virtual viewpoint image.

The boundary hole is mainly due to the limitation of the camera field of view. There will be a few pixels wide hole area at the virtual viewpoint image boundary. The boundary hole increases as the distance between the reference viewpoint and the virtual viewpoint position increases, especially for horizontally placed cameras.

2.5.2. Problem of Artifacts. In addition to the hole problem, the edge contour of the foreground object often appears in the background area of the generated virtual viewpoint image. This kind of problem is called “artifact,” which is also called false edge in some literature. There are two main reasons for this problem. First, different reference viewpoints will have subtle differences in lighting conditions due to different viewpoints. The difference in pixel color will appear in the image, which leads to the use of multiple reference viewpoints to synthesize virtual. In the viewpoint image, based on the mapping of the main reference viewpoint, when the auxiliary reference viewpoint fills in the hole, the difference in the pixel color causes the color of the filled hole area and the main reference viewpoint itself to deviate, which will form at the edge of the previous hole “artifacts” problem. Second, under the same viewpoint, the color image and the depth image are not completely corresponding, especially the transition area of pixels at the edge of the object is different. In the depth map, the pixel depth value of the edge of the object is abrupt, and the transition area is generally sharper, while in the color map, the transition pixel at the edge of the object is relatively smooth, resulting in the edge contour of the foreground object due to the inaccurate depth

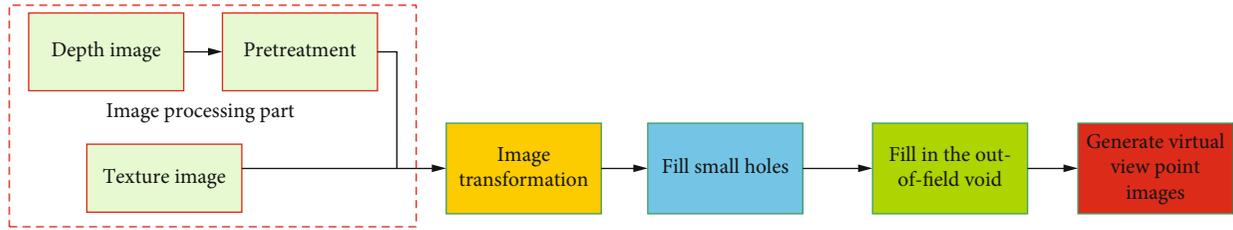


FIGURE 4: Method flow chart.



FIGURE 5: Original image (left); processed pseudocolor depth image (right).

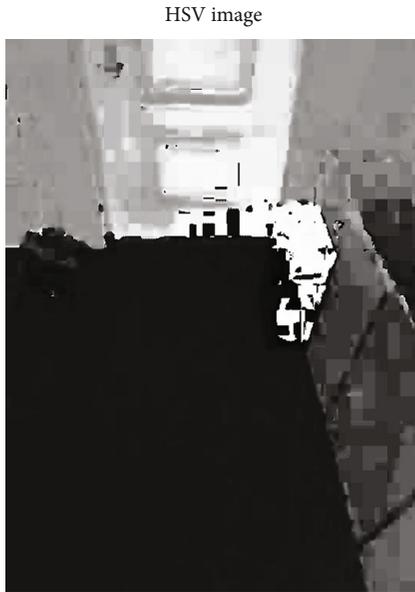


FIGURE 6: Deeply processed image.

value during pixel mapping. The background area projected on the virtual viewpoint image forms “artifacts.”

2.5.3. Overlapping Issues. The overlap phenomenon, as the name implies, is that multiple pixels at different positions in the reference image are mapped to the same position in the virtual viewpoint image due to imprecise depth values. There are two main reasons for this problem: First, the discontinuity of the depth value of the reference image, espe-

cially for the edge pixels of the object, so that the adjacent pixels are mapped to the same pixel coordinate of the virtual view image because of their depth value relationship. Second, due to the objective occlusion between objects in the scene, it may cause the two pixels visible under the reference viewpoint to be mapped to the virtual viewpoint to overlap.

2.5.4. Time Continuity Issues. At present, most of the algorithms to solve the problem of “artifacts” and holes are limited to the repeated processing of each frame of the virtual viewpoint image, ignoring the relationship between the image frame and the frame. As a result, starting from the video sequence as a whole, the time continuity of the image sequence cannot be maintained, which will cause offensive flicker problems, especially at the edge of the object [30].

3. Experimental Setup

3.1. Introduction to the Experiment. This experiment proposes a hole-filling DIBR method [31]. This method uses the texture information of a single viewpoint and its corresponding depth information to form an image under a virtual viewpoint through image transformation and solves the artifacts and artifacts generated in the virtual viewpoint synthesis process [32].

3.2. Experimental Process. As shown in Figure 4, it is the flow chart of the experimental method in this paper. First, image processing is performed on the image. After the image is transformed, small holes are filled. After the small holes are filled, there are still holes, the out-of-field holes are filled, and the virtual viewpoint image is finally generated [33].

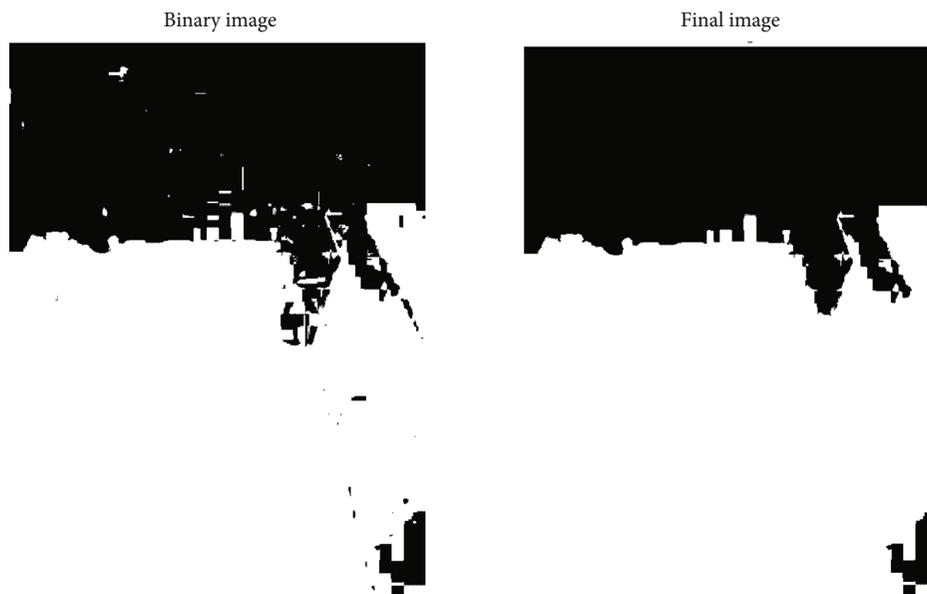


FIGURE 7: There is a small space (left), after filling the small space (right).

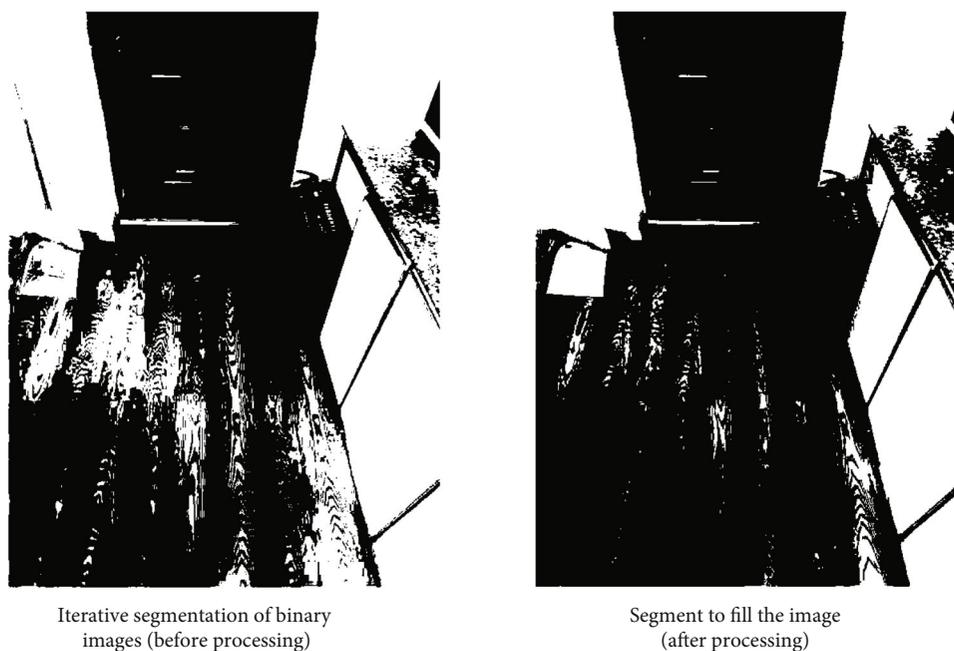


FIGURE 8: Image before filling (left); image after filling (right).

3.3. Specific Methods

3.3.1. *Image Transformation Processing.* Bilateral filter pre-processing is performed on the depth map of the reference viewpoint to protect the edges and remove noise to smooth the depth map.

As shown in Figure 5, the left image is the original image, and the right is the processed pseudocolor depth image [34]. Observing the image, it can be seen that objects at different distances are clearly distinguished, but only relying on color is not relatively intuitive to see how far the object is from the camera [35].

Figure 6 shows the image after the depth processing. When the data is converted to the gray value of the pixel through the linearization method, the gray value distance is close and difficult to distinguish, and the distribution is too concentrated, which affects the intuitiveness of the image [36]. Therefore, in order to solve the unnatural color transition in the image and the inability to present a uniform and layered visual effect, the image needs to be deeply processed.

3.3.2. *Fill Small Spaces.* The image on the left of Figure 7 is a mapped image with a small space, and the right is an image after filling in the small space. In the mapped image, for

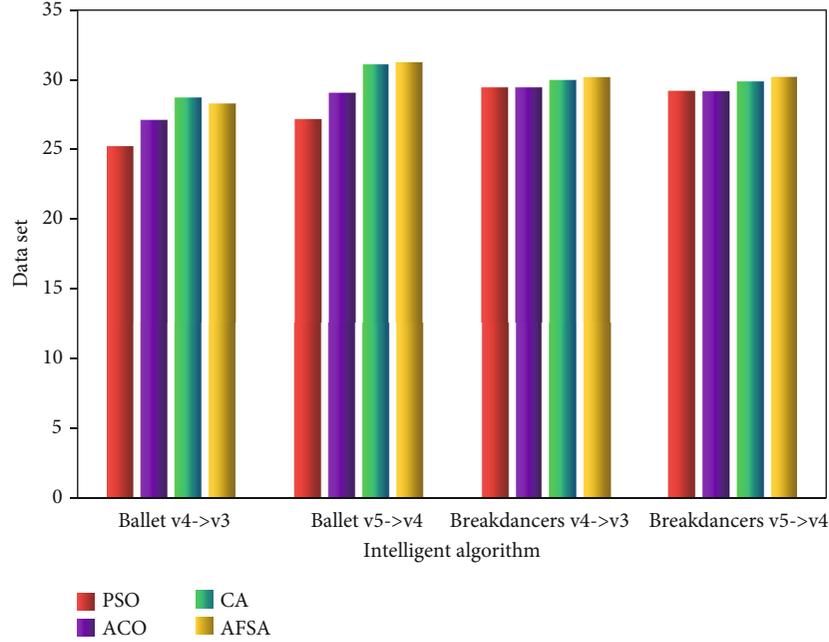


FIGURE 9: Comparison of the average PSNR of different test data sets and different methods.

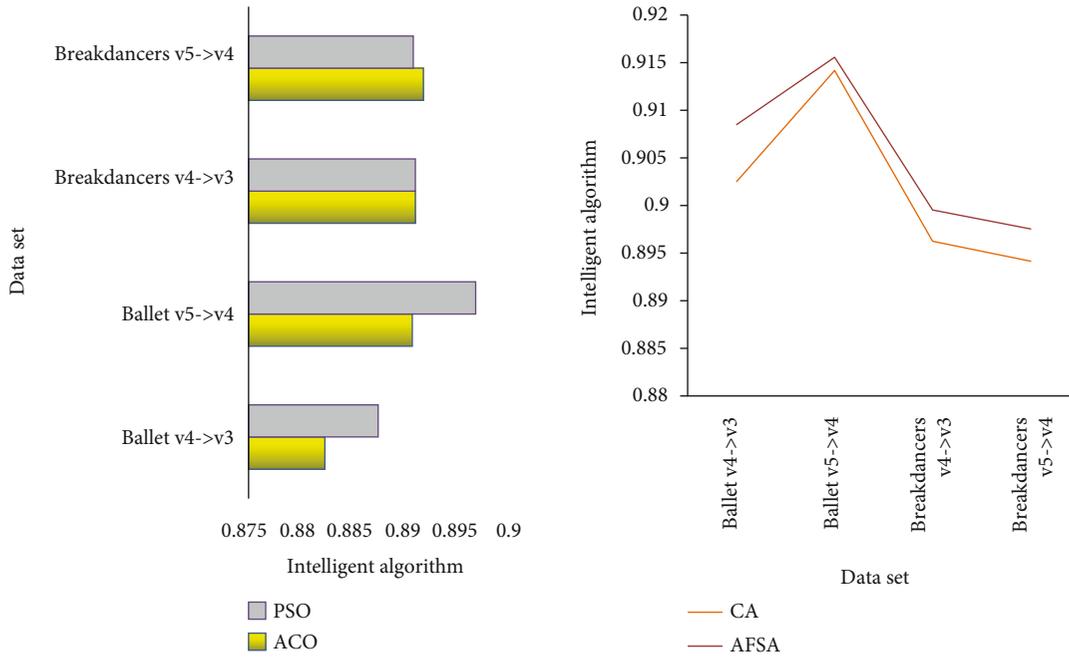


FIGURE 10: Comparison of average SSIM for different test data sets and different methods.

small holes, this document uses the method of filling small holes layer by layer, first filling the boundary points of the hole, and then placing the filling layer inside the layer, avoiding the use of image restoration methods to fill the holes, which saves time. For the off-site blanks, this paper adopts an improved intelligent algorithm, uses weighted average structural trend data elements to maintain the local consistency of texture depth information, and uses an improved

block distance calculation formula to improve image quality to fill the holes.

3.3.3. *Generate Binary Image of Virtual Viewpoint.* As shown in Figure 8, the left side is the binary image before filling, and the right is the binary image after cutting and filling using the Otsu threshold algorithm. In order to reduce the filling order of foreground pixels at the limit of the hole, to avoid

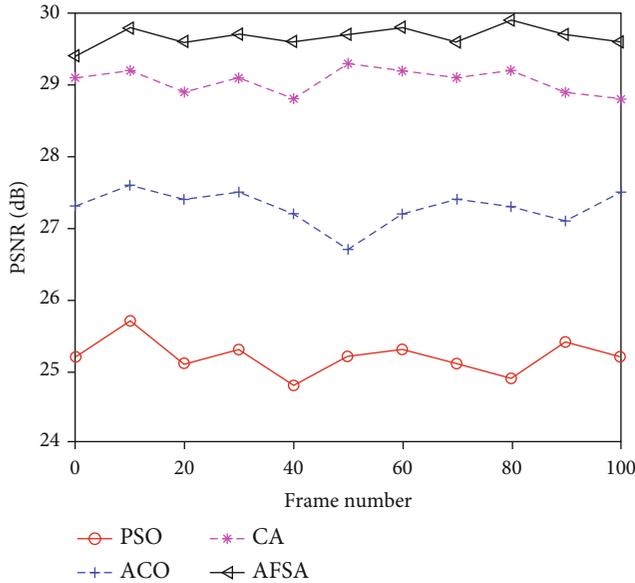


FIGURE 11: PSNR comparison of different methods of BA43 at 100 frames.

the mismatch of foreground pixels and lead to filling errors, on the other hand, a new source space recognition method is proposed, which uses depth and threshold information to recognize the relevant background part as a candidate block search area. While improving the frontal mismatch, it effectively maintains the local consistency of the relevant background texture.

4. Experimental Results and Analysis

4.1. Comparative Analysis of Objective Quality. This article adopts two objective evaluation standards, PSNR and SSIM. PSNR is a very common objective evaluation standard for image quality. The unit is dB. The larger the value of PSNR, the better the image quality of the virtual viewpoint. SSIM is an evaluation of the similarity index of image structure. The closer the value of SSIM is to 1, the better the quality of the image.

As shown in Figure 9, for the cavity area, this paper uses the four methods of swarm intelligence algorithm PSO, ACO, CA, and AFSA for experimental comparison to solve the problem of cracks and artifacts in the image change process. It can be found that the final text AFSA algorithm works well, except that it is slightly lower than the CA algorithm in the Ballet v4 > v3 data set, and the other data sets are higher than other algorithms.

As shown in Figure 10, it is the experimental comparison between the PSO and ACO algorithms, and the CA and AFSA algorithms in this article. It can be seen that the ACFA algorithm in this paper is one head higher than the CA algorithm in each data set field. Whether it is PSNR comparison or SSIM comparison, the filling effect of this paper is more obvious, and the filling result is the best.

As shown in Figure 11, it is a 100-frame PSNR comparison of the test sequence BA43. This is a more intuitive data

comparison algorithm than the above figure. It can be clearly seen that the algorithm in this paper has a higher PSNR than other algorithms, which is about 20% higher than the traditional PSO algorithm.

As shown in Figure 12, it is a 100-frame SSIM comparison in the test sequence BA43. It can be seen that the AFSA algorithm is significantly higher than other algorithms. In the second half of the test series, although there are individual jitters, it is more stable than the other three algorithms, has better robustness, and has a better effect of filling holes. It is good. On SSIM, the performance of this algorithm is up to 4.6% higher than the traditional algorithm, and the lowest is 2.2%.

4.2. Status Quo of Wireless Network Research. The development in the past two decades is mainly reflected in the continuous upgrading of hardware technology and the continuous maturity of various network-related technologies, and good research theoretical results and technical application results have been achieved.

As shown in Figure 13, it is the distribution map of the previous research directions of wireless sensor networks. A wireless sensor network refers to a group of spatially dispersed and dedicated sensors used to monitor and record the physical conditions of the environment and organize the collected data in a central location. In a sense, they are similar to wireless ad hoc networks. They rely on wireless connections and the spontaneous formation of the network, so sensor data can be transmitted wirelessly. A wireless sensor network is a spatially distributed autonomous sensor that is used to monitor physical or environmental conditions, such as temperature, sound, and pressure, and transmit its data to the main location through the network. More modern networks are bidirectional, so control sensor activities can also be carried out. In the past research, energy issues have been studied the most. Energy consumption is the most important problem to be solved in the initial stage, which restricts the development of other technologies, followed by network routing. There are several key technologies such as technology and positioning issues.

As shown in Figure 14, it is a distribution map of the current research directions of wireless sensor networks. It can be seen that in continuous practice, new problems continue to arise, and people are paying more and more attention to issues such as security and mobility. Nowadays, the development of science and technology is continuously spreading to the field of life and production, which has received extensive attention and is in line with the needs of the development of the times.

4.3. Nonrange Positioning Algorithm. The positioning based on the measurement distance can achieve accurate positioning and is suitable for applications in situations that require high position accuracy but often requires high hardware requirements for wireless sensor nodes. In some cases where accuracy requirements are not too high, nonrange positioning technology can also be used.

From Table 2, this table is a comparison table of no-test and no-distance algorithms. The above four algorithms have

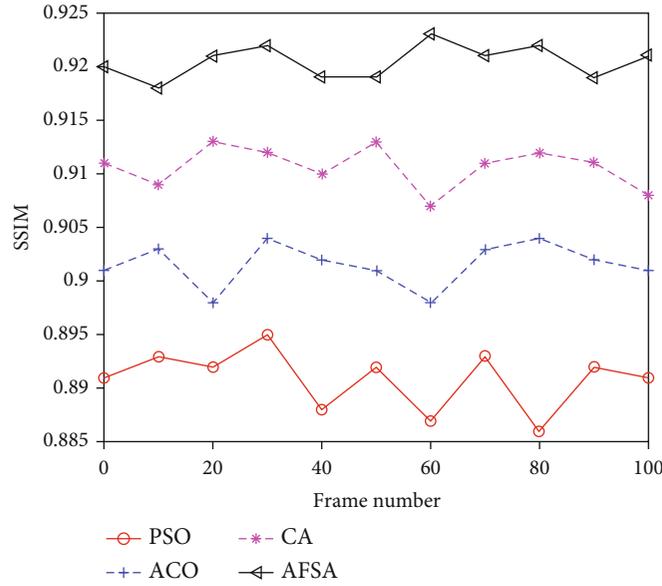


FIGURE 12: 100-frame BA43 SSIM comparison with different methods.

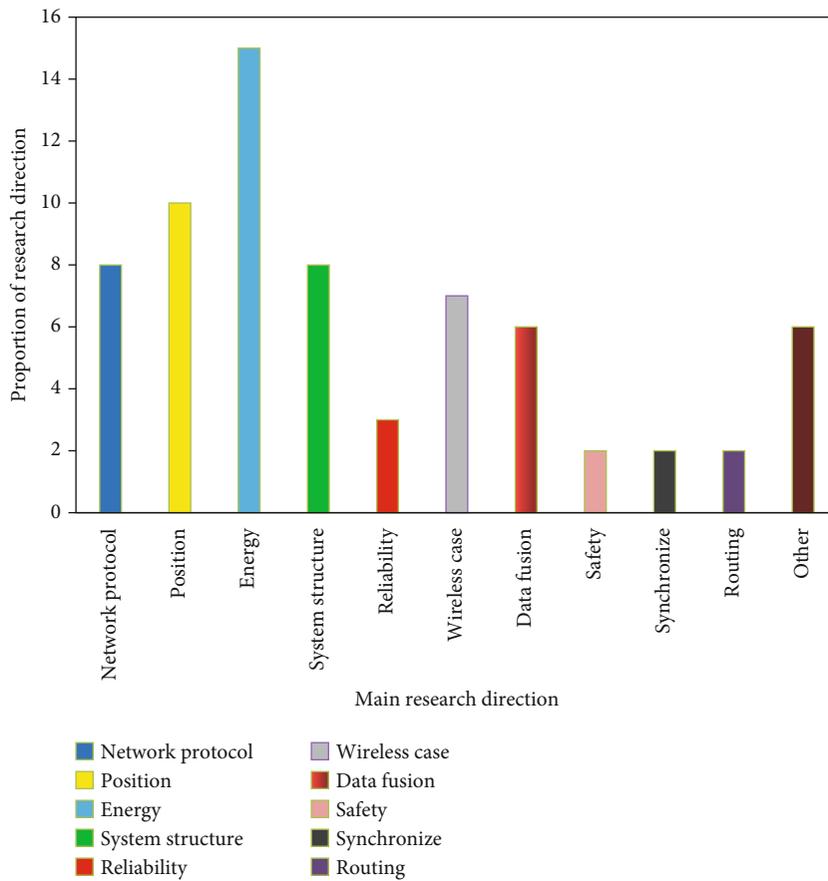


FIGURE 13: Distribution of previous research directions in wireless sensor networks.

their own advantages and disadvantages. DV-Hop is a wireless algorithm that is not based on distance measurement. After the node is deployed, the minimum number of hops and each by multiplying the average distance of hops, the

distance information from the node to be located to 3 or more anchor nodes is obtained. The MDS-MAP algorithm is a centralized positioning algorithm, which solves the node coordinates through the connection of the node-ranging

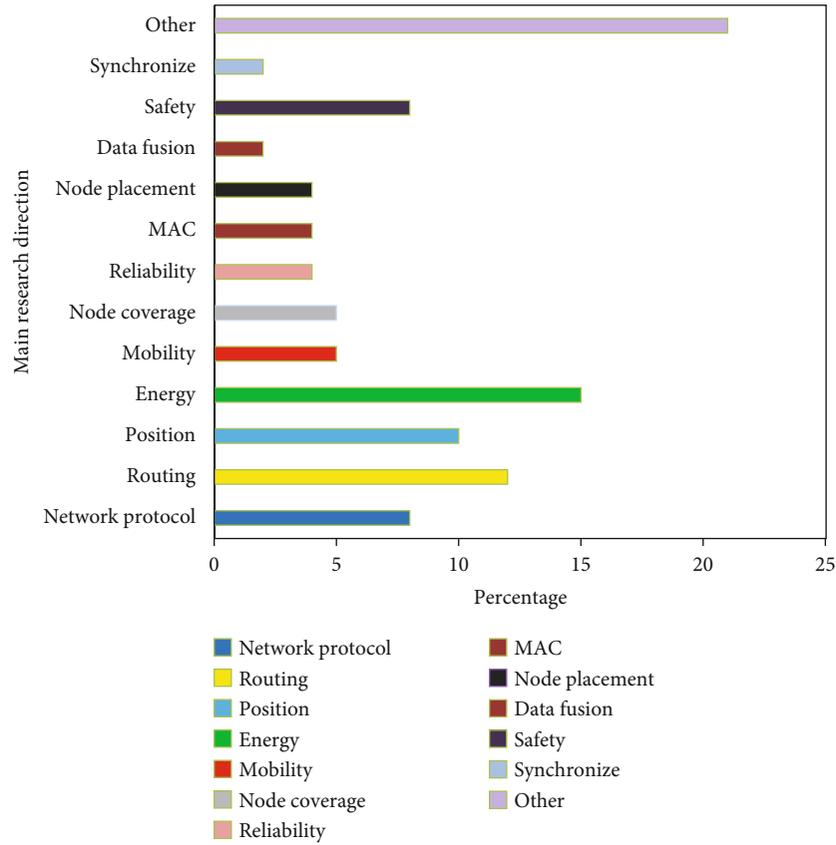


FIGURE 14: Distribution of current research directions in wireless sensor networks.

TABLE 2: Comparison of ranging and positioning algorithms.

Algorithm name	DV-Hop algorithm	MDS-MAP algorithm	Convex algorithm	APIT algorithm
Accuracy	Good	Good	Good	Good
Node density	Bigger	Bigger	Bigger	Bigger
Anchor node density	Smaller	Smaller	Smaller	Maximum
Irregular transmission	Smaller	Bigger	Bigger	Smaller
Anchor node positioning error	Smaller	Bigger	Bigger	Smaller
Communication overhead	Maximum	Smaller	Bigger	Smaller

information and the neighbor relationship between the nodes. The Conex algorithm can get the estimated coordinates of nodes based only on the connectivity between nodes. The APIT algorithm is very intuitive through graphical description, including unknown nodes, and calculating the centroid of the polygon including the unknown node as the final position of the unknown node. The accuracy of these four algorithms is very good, and the node density is relatively high. Although the APIT algorithm has the largest anchor node density, the transmission is irregular and the positioning error is small. Each algorithm has its own outstanding points.

5. Discussion

This article is mainly based on the wireless network communication intelligent algorithm and proposes a virtual view-

point synthesis method based on image restoration technology, which combines the wireless network communication intelligent algorithm with the image restoration technology to obtain high-quality virtual viewpoint images. Image-based virtual viewpoint generation technology has the following advantages: (1) image-based virtual viewpoint generation methods are mainly traditional image processing algorithms, and the program implementation is relatively simple; (2) the requirements for camera equipment used to obtain reference images are low, no professional equipment is required, and better results can be obtained through civilian digital cameras or even mobile phone lenses; (3) since only image processing technology is used and there is no need to perform 3D reconstruction of objects in the scene, image-based virtual viewpoint generation technology is less restricted by the scene. It will not affect the effect due to the excessive complexity of the scene or the presence of light

interference and other factors; (4) for the same reason that there is no need for three-dimensional reconstruction, the results obtained by image-based virtual viewpoint generation technology will not have sharp edges and inaccurate textures due to insufficient modeling and will not affect the reality due to excessive geometric traces.

With the rapid development of science and technology and the continuous improvement of the public's requirements for visual experience, virtual viewpoint generation technology has gradually entered people's sight and has become a hot issue in the field of computer vision. At present, there are many excellent applications based on virtual viewpoint generation technology, and they can all bring excellent visual experience. There are many schemes for the generation of virtual viewpoints, among which the schemes that can obtain shocking effects require expensive equipment and complex calculations. The virtual viewpoint generation algorithm based on the depth image can achieve a balance between the implementation effect and the cost and obtain better results with a lower investment. At the same time, image restoration technology also has many goals and applications. For example, in the photography and film industries, this technology is used to repair movies and restore deteriorated films. It can also be used to remove red eyes, dates on photos, watermarks, etc., and even some special effects can be achieved. Image restoration technology can also be used to replace lost data during the encoding and transmission of digital images. In the future, image restoration and virtual viewpoint video synthesis based on intelligent algorithms for wireless network communication will also become a key research object.

6. Conclusion

With the development of artificial intelligence and machine vision, the depth information of the scene is playing an increasingly important role, and the depth image, as a common technical means to obtain depth, is more and more widely used in research. In this paper, by consulting related literature, the virtual viewpoint rendering technology is researched, and the method of virtual viewpoint rendering based on depth images is improved. In order to reduce the computational cost of rendering, the image generation and image simplification were studied, and several existing depth extraction techniques were evaluated. Some of the most advanced methods have been modified to adapt to actual conditions. By comparing the efficiency of several wireless network intelligent algorithms and the quality of generating new viewpoints, it is concluded that the improved algorithm in this paper is more efficient and the quality of new viewpoints generated is better. Compared with the traditional fixed-weight fusion method, the algorithm used in this paper has better virtual view image quality results. Due to the limited time and energy, there are still many areas worthy of further study in the work of this article. For example, due to the inaccuracy of the depth map, the projection error in the drawing process may be caused. The next research can consider the combination of a depth camera and a stereo matching algorithm to maximize the accuracy of the depth

map, how to better use time domain information to improve the filling of holes, and so on. In the future, we will explore that when the human eye actually observes three-dimensional objects in space, the left and right eyes will receive scene images from different angles. The three-dimensional display system simulates this process by allowing the viewer's left and right eyes to see images from two different perspectives. After the human brain observes the images from the two perspectives, it uses the convergence-focusing process, and the objects in the image have a front-to-back occlusion relationship, and combines past experience and other factors to comprehensively construct the structural information of the entire three-dimensional space. Form a sense of depth that is different from traditional two-dimensional images, The three-dimensional video presentation methods all take advantage of this feature, allowing viewers to observe images from different perspectives through different means, so as to obtain a three-dimensional experience.

Data Availability

No data were used to support this study.

Conflicts of Interest

The author states that this article has no conflict of interest.

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