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Cropping Algorithm Based on Crop Image Sequence

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Keywords: Image Stitching, Image Fusion, Image Registration, Image Sequence, Feature Point Detection

Abstract: Image stitching technology involves computer graphics, pattern recognition, image processing, and other aspects. It is an interdisciplinary topic and has always been a research hotspot in image processing and computer vision. It is widely used in video understanding and analysis, target detection and tracking, image processing and analysis. Therefore, the research on image stitching technology is very meaningful. This paper mainly studies the stitching algorithm based on crop image sequences. In this paper, according to the transformation matrix calculated by the original SURF algorithm, the rotation angle of the image is 66.89°, and the rotation angle obtained by the algorithm is 65.69 °. The difference between the two is about 1°, and the error is only 1.8%. Accurate results are also relatively high in accuracy. It can also be seen from the comparison of the overall transformation matrix that the two algorithms are very close in the obtained matrix results. In addition to the relatively accurate rotation angle, the error of the translation amount is also about one pixel, achieving high accuracy. Sex. It can also be seen from this experiment that the algorithm in this paper still maintains good results when the rotation angle reaches more than sixty degrees. Experimental results show that the algorithm in this paper can significantly improve the visual effect of the fused image and obtain ideal image output.

1. Introduction

With the development of the information society, people are exposed to more and more kinds of information in their lives. Among them, image information is the most important way for people to obtain information. In normal life, if people want to take a picture of a relatively large scene, in order to include all the objects in the scene, the focus of the camera must be adjusted to increase the angle of view of the camera, but the problem this brings is the image Some objects in the image may be blurred, and the details are less sharp. However, taking a high-resolution picture with a reduced camera angle cannot obtain comprehensive scene information. And under the constraints of objective conditions, sometimes a picture cannot contain an ultra-wide scene image of all objects, so the stitching technology of the image is particularly important. With the help of image stitching technology, it is not necessary to use expensive, complicated wide-angle cameras and other equipment, you only need to take pictures of specific scenes with ordinary cameras that meet the resolution requirements, and then use the image stitching software algorithm to stitch these image sequences. A panoramic image with a wide viewing angle can be obtained, which can not only ensure the effect, but also greatly reduce the cost.

Image stitching technology has a wide range of application prospects, and the research and development of image stitching theory will continue to attract people's attention [1-2]. Through the stitching of crop sequence images, the data of crop area and cultivated land can be counted, and the monitoring and evaluation of crop characteristics and growth processes can be realized. The processing of satellite remote sensing images can realize the investigation of agricultural resources, and the crop area and disaster. Evaluate the situation of the epidemic situation; also realize the classification, grading and quality inspection of crop products, such as maturity, variety identification, etc.; realize the digitalization, modernization and informationization of agriculture. Therefore, in-depth research on this subject is of great practical significance to the development of China's image mosaic technology, especially crop mosaic image generation technology, and is conducive to promoting the application of this technology in agricultural production [3-4].

Dong proposed an improved SURF algorithm for image registration methods based on the SURF algorithm, which has the problems of redundant feature extraction, large amount of calculation, and low matching accuracy. He uses the Hessian matrix to extract feature points; then uses the Hear wavelet response to construct a feature descriptor for each key point in the circular neighborhood, and simultaneously calculates the normalized gray value difference and second step of the region. Finally, the RANSAC algorithm is used to eliminate mismatches. His method not only performs faster than the SURF algorithm, but also makes full use of the gray level information and detailed information of the image, and obtains higher accuracy. His experimental results show that the method is robust and stable to blurring, poor illumination, angular rotation, and viewpoint changes. During the mosaic of remote sensing images, a mosaic image of well edges without obvious geometric deviation was obtained. His method is an efficient image registration algorithm, which has the advantages of fast speed and high accuracy, and meets the needs of remote sensing image mosaic registration [5]. Zhang believes that image stitching between images with large changes in lighting will produce unnatural stitching images. In response to this problem, he proposed an image mosaic algorithm based on histogram matching and scale-invariant feature transform (SIFT). First, histogram matching is used for image adjustment, so image stitching is the same level of lighting, and then the filtering algorithm is used to extract the key points of the image and the matching process is performed. Second, the RANSAC algorithm is well matched, and finally he calculates the appropriate mathematical two. Based on the mapping relationship, a simple weighted average algorithm is used for image fusion. His experimental results show that the algorithm is effective [6]. Z. Cheng proposed a fast and effective stitching algorithm based on the position and attitude information of the drone in view of the large calculation amount of the existing aerial image stitching methods. First, he obtained the coordinates and attitude angle of the drone through the on-board GPS and inertial measurement unit (IMU). Each aerial image has corresponding position and attitude information. Calculate the homograph matrix between two aerial images with position and attitude information. Then the registration of the stitched image is obtained by the operation of the homograph matrix. Finally, multiple images are stitched together to obtain the entire panorama. His numerous experiments have proved the effectiveness of the algorithm [7].

The innovations of this paper: (1) this paper applies image-aware hashing algorithm to overlap area detection. Perceptual hashing algorithm is a simple and fast image algorithm. It extracts the low-frequency contour information of the image through the idea of image compression and generates the hash value of the image. To achieve rapid extraction of image features. (2) This paper designs a fast search algorithm for area detection in the overlap area detection algorithm. On adjacent sequence images, starting from the overlapping edges of the respective images, the search range is gradually expanded by a certain step size until the best matching range is found. The optimal search step size can be determined according to the actual size of the image to be processed, which enhances the applicability of the algorithm.

2. Proposed Method

2.1. Image Stitching

(1) Image stitching definition

As shown in Figure 1, image stitching refers to the registration and fusion of two or more images with partially overlapping scenes to finally obtain a stitched image with a larger perspective.

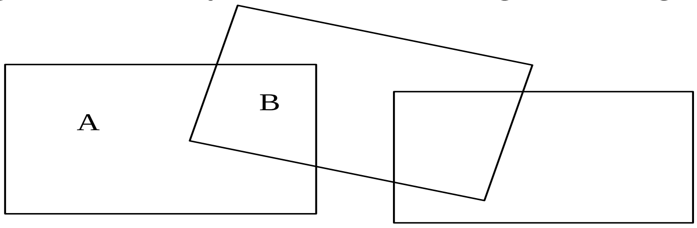

Figure 1. Schematic image stitching

Assume that A and B are the two images to be stitched, and T represents the coordinate space transformation relationship of the corresponding points of the two images. Let x and x 'be a set of corresponding points on images A and B, and x = T (x'). Image A is referred to as the reference image, and image B is the floating image.

(2) Basic process of image stitching

1) Image pre-processing

The main purpose of image pre-processing is to perform certain pre-processing operations (such as distortion correction, denoising, etc.) on the collected original pictures according to the image acquisition situation and actual application requirements, so as to provide better input for subsequent processing. In this article, the image acquisition is a general USB camera, the distortion is very small, mainly the processing of noise. Subsequent feature extraction and matching of the denoised pictures can improve the final stitching effect.

2) Image registration

Image registration is the core step of image stitching, and the accuracy of registration directly determines the effect of final image stitching. Image registration is a spatial transformation that can characterize the spatial position relationship between two images through a certain algorithm. While ensuring high accuracy, this algorithm also requires low computational complexity.

3) Image fusion

Image fusion is based on image registration. After spatially transforming the floating image, image fusion is performed on the overlapping parts of the two images, and finally a natural and clear stitching image is synthesized.

2.2. Image Transformation

(1) Image coordinate system

In actual research, the camera is abstracted as a pin hole, and the geometric relationship of imaging is the relationship analysis of the actual scene through which the image is formed. Therefore, this geometric relationship is also called perspective projection. When the camera takes a picture, the actual scene is three-dimensional. The actual coordinate position of the scene point and the depth perspective relationship can be identified by the spatial three-dimensional coordinate system. After imaging on the photo, the photo information is two-dimensional. Image point coordinates can be represented by a two-dimensional point coordinate system. Therefore, it is not difficult to see that there is a coordinate transformation relationship between the scene point and the image point when the camera is imaging [8-9].

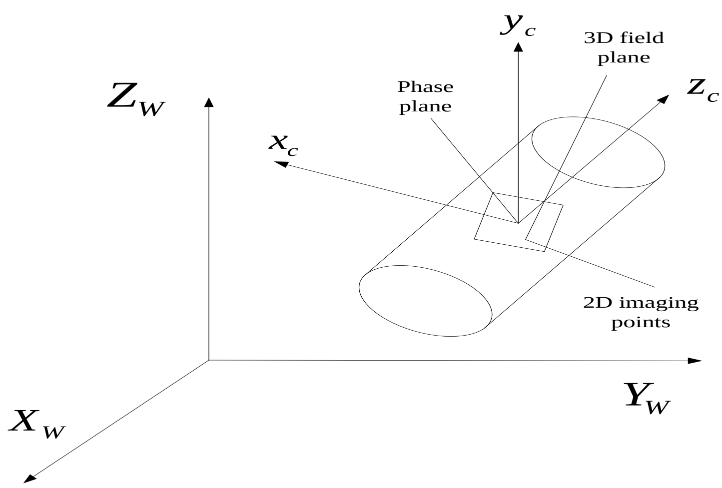

Figure 2. Three-dimensional scene space coordinate system and camera coordinate system

As shown in Figure 2, a schematic diagram of the space coordinate system and the camera coordinate system. The spatial arrangement of the scene is the real scene point coordinate XYZ, with the ground origin as the reference point (or a point in the shooting scene after being transformed with the ground origin), and the real scene coordinate point represents the actual coordinate value of the scene. Under this coordinate system, the value of a point in the scene needs to be considered in applications such as 3D reconstruction. In the field of image stitching, this coordinate system usually assists in deriving the imaging model without paying attention to its actual value [10-11].

The camera coordinate system is the camera-centered coordinate xyz. It transforms the actual coordinate point of the scene into the coordinate form of the camera's observation center. The optical axis of the imaging is generally represented by the z axis, and the plane determined by the xy axis is parallel to the image plane. This is a form of representing the absolute three-dimensional coordinates of the scene as relative three-dimensional coordinate values. In special cases, for example, when the shooting scene is an absolute plane scene (the same z value), the change from the camera coordinates to the image plane coordinates can be greatly simplified.

Generally speaking, the three-dimensional spatial coordinates of the scene and the three-dimensional coordinates of the camera's pose will not completely coincide. There will be a certain transformation relationship due to the camera's rotation, translation, and other operations. These relationships can be used in a 4 × 4 matrix Means. The relationship between the camera coordinate system and the space coordinate system is shown in equation (1):

$$\begin{pmatrix} X_c \\ Y_c \\ Z_c \\ 1 \end{pmatrix} = \begin{pmatrix} R & T \\ 0 & 1 \end{pmatrix} \begin{pmatrix} X_W \\ Y_W \\ Z_W \\ 1 \end{pmatrix} = M \begin{pmatrix} X_W \\ Y_W \\ Z_W \\ 1 \end{pmatrix} \tag{1}$$

In the formula, the subscripts C and W respectively represent the scene point values in two different coordinate systems, and T represents the amount of horizontal or vertical movement.

2.3. Image Transformation Model

(1) Two-dimensional transformation model

The geometric model of the transformation relationship between image sequences is determined by the changes in space when the camera is imaging (because the spatial state is not fixed when the camera is shooting), so the scenes taken have different forms. Common are two-dimensional transformation models and three-dimensional rotation models. The two-dimensional image transformation model is mainly related to the shooting position and state of the camera. Among these types of transformation models, rigid body transformation includes two types of operations: rotation and translation around the optical axis (O translation transformation is a special case), because this side transformation can keep the Euler distance unchanged, so it is also called Euler transformation; In the above transformation, the perspective projection transformation is the most commonly used model to represent the geometric relationship between images, because it can describe the imaging Attitude, of course, it has the most number of parameters. In practical applications, the previous models need to have a special condition limit, and this type of transformation also has the least limitation on the imaging method, so its degree of freedom is also the largest [12-13].

(2) Spherical transformation model

Since the subsequent image stitching in this paper is based on spherical stitching, a brief introduction to the spherical transformation model is made here. As mentioned earlier, the camera position is not fixed during actual shooting, so the imaging model of the image is relatively complicated. In practical applications, in order to simplify the problem description, some special restrictions are usually made. For example, the spherical transformation model is required to shoot When the camera is still at a fixed point, its shooting attitude can be changed at will (approximately true). At this time, multiple photos form a spherical model. When the images are stitched, they can be mapped to the spherical surface.

2.4. Image Transformation Implementation and Interpolation Techniques

(1) Forward transformation

Starting from the original image data, the image matrix is checked point by point in a two-dimensional loop, and it is calculated on a certain plane or sphere. Because many transformation models (such as projection transformation matrices) have a single mapping, that is, each pixel of the source image can only be mapped to one point of the destination image, otherwise it is not true (some pixels of the destination image may not be found in the source image. point). Therefore, if a forward transform is used, a "hole" is created.

(2) Inverse transformation

You can use the inverse transform to solve the above problem, that is, for each point of the destination image, inverse transform to the source image to find its corresponding point. The steps of inverse transformation are: firstly calculate the boundary area of the destination image using forward transformation according to the vertices of the known image, and then inversely transform each point in the destination image area to the source image according to the inverse matrix of the mapping matrix point. Because each point in the destination image area is inversely transformed back to the source image, it is in the image area, so it can effectively solve the "whole" problem

(3) Interpolation technology

The coordinate points obtained by the inverse transformation in this paper are not necessarily integers. If the direct interception may cause the target image to be not smooth enough, an interpolation technique can be selected to solve this problem. There are three commonly used difference algorithms described below. Nearest-neighbor interpolation is the value of the interpolation point to select the pixel value closest to it. Because a pixel has eight neighborhood points, the selection of the nearest-neighbor interpolation point is subjective in actual operation, so its error is large. It is also usually large, and the difference is not very good.

Bilinear interpolation is a method to obtain the value of the point by weighting the average of the four neighboring points around the interpolation point. The weight of the four neighboring points and the pixel coordinate value of the point to be interpolated are: relationship. Assuming that the decimal coordinate of the point to be interpolated is (i + u, j + v), the method of bilinear difference is to determine its four neighborhoods according to the coordinate of the point to be interpolated, and then use formula (2) to calculate its final insertion. The pixel value of the point, that is:

$$f(i+u, j+v)=(1-u)(1-v)f(i, j)+(1-u)vf(i, j+1)+u(1-v)f(i+1, j)+uvf(i+1, j) \qquad (2)$$

As in formula (2), the amount of bilinear difference calculation is much larger than the simple nearest neighbor difference, but the calculated pixel value is better. At the same time, the calculation is equivalent to the weighted average of the surrounding pixels. So it will make the image smoother. If multi-resolution interpolation is performed, the image may be blurred.

Equation (3) shows the form of bicubic interpolation:

$$f(x,y)=\sum_{i=0}^{3}\sum_{j=0}^{3}a_{ij}x^i y^j \qquad (3)$$

The first interpolation method can see the obvious unevenness. The latter two interpolation methods have little difference in effect, but the bilinear interpolation is more efficient than the bicubic interpolation. Therefore, this article uses the bilinear interpolation as the basic Interpolation method.

2.5. Feature Point Detection Technology

Image feature points usually refer to those points that differ greatly from their neighboring pixels in certain attributes. Feature points may differ from neighborhood points in attributes such as brightness, color, curvature, or texture. Feature point extraction algorithms extract those points that differ by one or more attributes from surrounding points. For the needs of subsequent processing and enhancing the robustness of feature points, a small area around the feature points is usually selected and a feature point descriptor vector is generated in a certain way. The multi-dimensional space vector of the feature points is the basic description basis of the feature points but different from other feature point sets. With this vector, the correct pairing between the feature points can be achieved.

Therefore, in terms of specific requirements, the feature points of an image sequence must meet the requirements of repeatability when extracted in different environments or in different environments. At the same time, in different application environments, the same feature points of the same image must be extracted. Accurate, different phenomena can not occur many times. At the same time, feature point extraction must satisfy locality as much as possible (do not participate in global pixels or have nothing to do with the whole world), and the number is moderate. Large and easily lead to large estimation errors), high efficiency, robustness several criteria:

Repeatability: Refers to the stability requirements of the feature point extraction algorithm on the perspective changes. The perspective of the picture sequence will have different differences. The same object will deform or lose some information under different perspectives. In this case, can the feature points be correctly extracted?

Accurate positioning: The image feature point extraction algorithm must be able to accurately locate the scale and position of the feature point;

Locality: Locality is required to improve the robustness of feature point extraction, because if locality is not satisfied, when an image in an image sequence is occluded, can the feature points of the area be correctly extracted;

Moderate number: The number of extracted feature points should be enough to ensure the accuracy of image matching and geometric model parameter estimation. However, too many feature points will increase the amount of calculation;

Efficient: Feature point extraction algorithm can be completed quickly; Robustness: It can also correctly handle slight image distortion.

(1) Method based on curvature of shape contour

The connection or intersection of lines in a graph or image usually has abrupt changes in the data. Therefore, one of the methods of feature point detection is to find its maximum curvature point along the contour line. The contour of the image and its curvature can be easily determined by parameter equations. However, for practically applied pictures, the curvature information is usually not obvious, and the curvature calculation is easily affected by noise or complex environments, so this method is not robust. At the same time, the estimation of the curve parameter equation is often more complicated in the discrete space established by the image, so there are fewer and fewer people in this field.

(2) Method based on brightness

When this type of method is used to detect the characteristics of an image, the Hessian matrix (second-order Taylor expansion matrix) and the first-order derivative matrix (gradient) of the pixel-value matrix of the image are usually used to calculate the typical examples of brightness-based methods such as Harris, SIFT, and SURF.

(3) Method based on color information

Image brightness information is actually just one dimension, and it has far less information than color information. The color of the image will have color blocks, will form contours, etc. Therefore, the reasonable use of color information can not only complement the use of brightness information, make the detected feature points more robust and practical, but also the color information itself can provide rich image matching. information. For example, the study of quaternions of image color information is its typical representative.

3. Experiments

3.1. Experimental Design

In this paper, an improved image registration algorithm based on the SURF feature operator is designed, and the improved performance and effectiveness of the proposed algorithm are verified by experimental comparison with the original algorithm. The experimental source image is shown in Figure 4.14. The experimental tool uses Matlab R2012b and Visual Studio 2013 software. The operating environment is under Windows 7, the CPU frequency is 2.67GHz, and the memory is 2GB.

Aiming at the two image fusion methods used in this paper, this paper adopts objective evaluation indicators for research and analysis. Three evaluation indexes: average gradient, information entropy, and standard deviation are used. The average gradient represents the sharpness of the image. The information entropy represents the richness of the image and whether there is any missing information. The standard deviation represents the difference after image fusion. The size reflects the quality of the resolution.

The cumulative error affects the global consistency of the stitched images. For example, when the vision sensor passes by the same location one after the other, the cumulative error will cause the spatial alignment of the front and back frames to be misaligned, and a globally consistent stitched image cannot be constructed. The advantage of the pose map is that it can be regarded as an elastic system. In order to eliminate cumulative errors, a limiting relationship can be established between closed-loop frame images that are far apart. This can pull all offset vertices back to the correct position. Align the stitched images globally.

3.2. Data Acquisition

This article uses data capture methods to obtain data. Due to uncontrollable factors such as displacement deviation and shooting jitter during the shooting process, after image registration, direct synthesis or using weighted average fusion will cause the color transition of the stitched images to be discontinuous, resulting in stitching seams. Artifacts also occur when direct fusion occurs when there are moving objects. Therefore, multi-resolution image fusion needs to be performed in the later stage of the stitching process. This paper first uses local color mapping and brightness equalization processing to reduce the exposure difference between the images to be stitched, and then effectively eliminates stitching seams by using an improved wavelet transform-based multi-resolution fusion algorithm.

4. Discussion

4.1. Analysis of Coincident Regions

Image perceptual hashing and the search algorithm designed in this paper are used to detect the overlap region of the experimental source image. The similarity detection threshold is set to 0.85, the initial step λ is 0.1, and the detection result of the overlap region is shown in Figure 3. The detection data results of the overlapped regions are shown in Table 1.

The experimental data pairs of the three algorithms are shown in Table 2. It is easy to see from the experimental data that the algorithm in this paper achieves a faster matching speed on the premise of ensuring the registration quality. In the feature point detection, since the effective coincident area is searched first, the feature point detection of the irrelevant area is omitted, and the original SIFT and SURF algorithms need to perform feature detection on the entire image. In comparison, the SIFT features The number of detections is the largest, reaching more than 3,000 in both images, and the SURF points are more than 1,000. If only calculated in the coincidence area, it can be seen from the results that the number of points is greatly reduced, and the feature points match The number is 26 pairs. Compared with the original algorithm, most matching pairs are retained. Compared with the original SURF algorithm, the detection time of feature points is shortened by nearly half, and the speed and efficiency of the algorithm are improved while ensuring the quality of image registration.

Figure 3. Detection results of coincident regions

Table 1. Overlap area detection data

Search times	λ	Similarity/%	Time-consuming/ms
16	0.58	89.06	180

Table 2. Algorithm data comparison

Algorithm	SIFT	SURF	Algorithm
Match logarithm	35	31	28
Detection time/ms	2032.74	1461.56	814.23

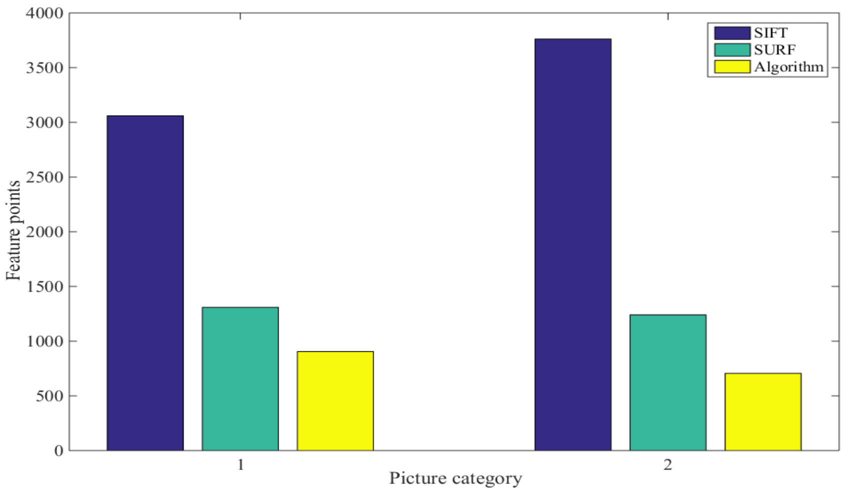

Figure 4. Picture feature point comparison

4.2. Analysis of Rotational Registration Results

Aiming at the large rotation between the sequences images, in order to verify the generality of the proposed algorithm and the applicable conditions, experimental tests were also performed. The picture has undergone a large rotation. The experimental results after matching by the SURF algorithm are shown in Figure 5.

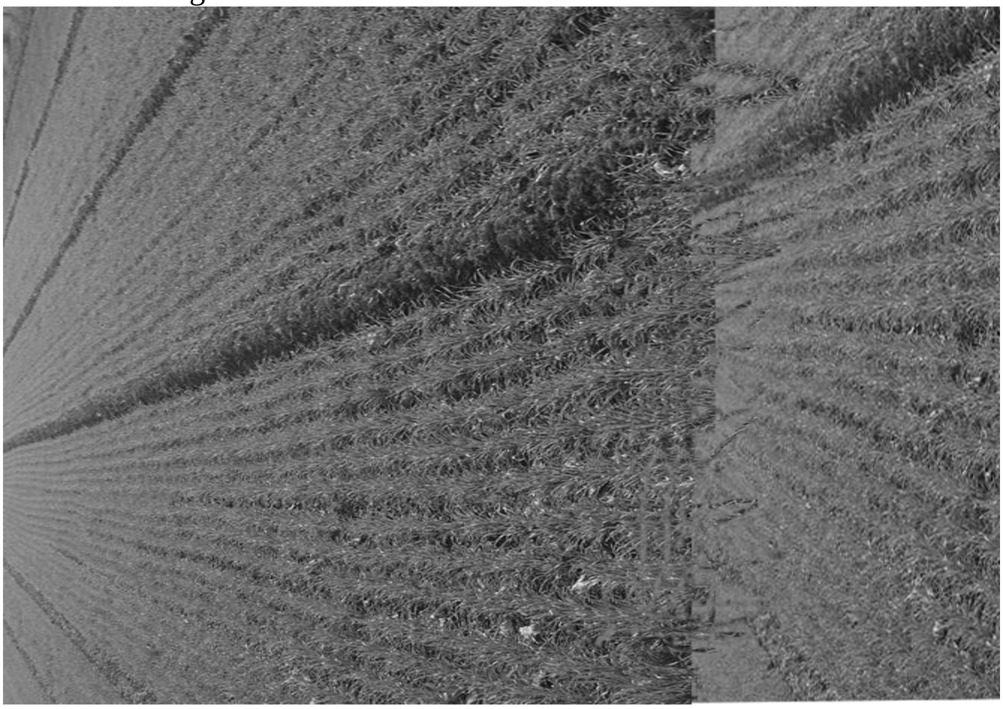

Figure 5. SURF registration results

Table 3. Overlap area detection data

Search times	λ	Similarity/%	Time-consuming/ms
15	0.55	78.14	260

Using the algorithm in this paper, the overlapped area of two images is detected first. It can be seen from the experimental results that the algorithm is able to detect the overlapped area more accurately even when a large rotation occurs. The detection data are shown in Table 3. It can be seen from the data that the similarity detected under the rotation condition also reached 78.14%, and the accuracy is still relatively high.

According to the transformation matrix calculated by the original SURF algorithm, the rotation angle of the image is 66.89 °, and the rotation angle obtained by the algorithm in this paper is 65.69 °. The difference between the two is about 1 °, and the error is only 1.8%. The algorithm in this paper guarantees accuracy. The result is also relatively high in accuracy. It can also be seen from the comparison of the overall transformation matrix that the two algorithms are very close in the obtained matrix results. In addition to the relatively accurate rotation angle, the error of the translation amount is also about one pixel, achieving high accuracy. Sex. It can also be seen from this experiment that the algorithm in this paper still maintains good results when the rotation angle reaches more than sixty degrees. This topic has verified the versatility of the algorithm based on multiple experimental tests. A good registration effect can be obtained when the angle is within about sixty degrees.

4.3. Objective Evaluation and Analysis of Image Quality

The objective evaluation method refers to the use of one or some specified parameters and indicators to judge the quality of the image. It has important research value in applications such as image fusion, compression, and image watermarking. It is a good or bad performance of different algorithms. Judging criteria. Its main idea is to imitate the intuitive feelings of people when they look at objects through certain indicators, so that the results are close to the effect of human subjective evaluation. There are many objective evaluation criteria, mainly as follows:

Evaluation criteria based on fused image statistical features. For example, the entropy of the image used to represent the richness of the information contained in the image content. The larger the entropy, the richer the information, the better the image effect; the larger the average gradient reflecting the sharpness of the image, etc., the larger the value, the clearer the result.

Evaluation index of fusion image based on ideal image. For example, the root mean square error (RMSE) that reflects the difference between the fused image and the ideal image, the smaller the RMSE, the better; or from the perspective of signal analysis, the difference between the images is treated as noise. Calculate the Signal to NoiseRation (SNR) or Peak Signal to Noise Ration (PSNR). The higher the SNR and PSNR values, the smaller the noise.

As shown in Figure 6, the fusion of the experimental pictures in this article is still taken as an example. Because the source image is a high-resolution and good-quality image, when calculating the objective evaluation index of the image, the original image can be used as the ideal image. The PSNR index of the image and the original image are used for evaluation, and the specific calculation range is the fusion region.

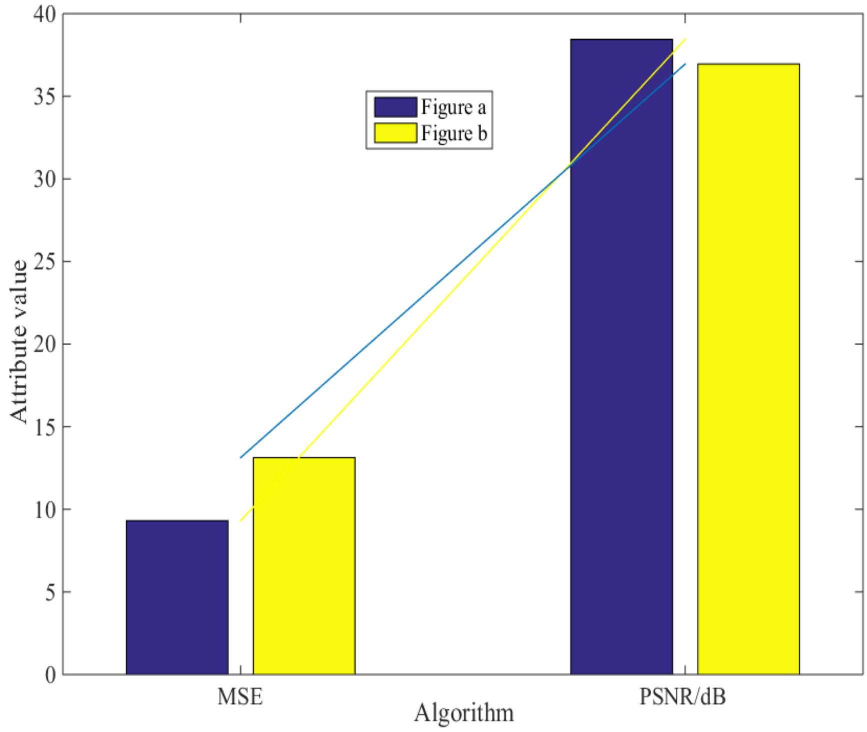

Figure 6. Objective evaluation index of fused image

4.4. Analysis of Subjective Evaluation of Image Quality

Subjective evaluation is to evaluate the results according to human judgment, and to calculate the quality of the image based on the results of human subjective perception. For example, a subjective evaluation method can be used to determine whether the contrast of the image is reduced, or whether the edge information of the image is blurred, etc., which is simple and practical. However, different people have different conditions in various aspects, such as life experience and preferences. The evaluation results will vary from person to person, so subjective evaluation methods are easily affected by subjective factors. At the same time, in the subjective evaluation, the evaluation personnel are generally divided into two groups, one is an ordinary person randomly selected, and the other is a person with specific training. The results are more accurate through experimental comparison.

As shown in Figure 7, from the perspective of subjective perception, the final fused image is relatively balanced in brightness and there are no obvious stitching marks. The morphological contours of the crops in the picture are also clear, and there is no obvious obstacle to the observation of the image. In objective data, the mean square error of the fused image and the original image is also relatively small; especially the peak signal-to-noise ratio is relatively high, indicating that the image quality is relatively high.

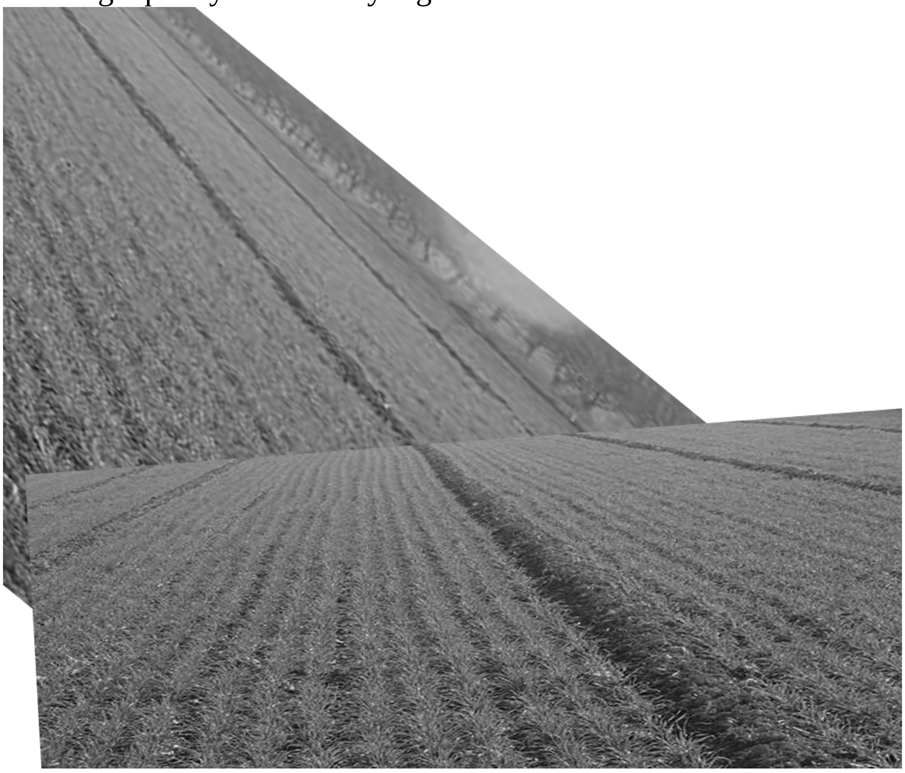

Figure 7. Image subjective evaluation chart

5. Conclusion

This article introduces several processes that image stitching has to go through, which can be summarized into three major steps: image preprocessing, image registration, and image fusion. Then compared the mainstream algorithm categories in this field, then focused on the SIFT and

SURF algorithms in the feature matching algorithm, analyzed and compared the algorithm ideas, and based on the SURF operator, combined with the image-aware hash algorithm to design A fast and accurate region search algorithm, and experimental comparison with traditional feature matching algorithms. Regarding the adjustment of the image output effect, according to the theory of image fusion, the image algorithms involved in the processing of the overlapped area are discussed. The registration results are smoothed and the overall image brightness is adjusted to ensure the output quality of the results.

This article describes the basic theory and application of perceptual hashing, focuses on the theory of image-based perceptual hashing, and proposes an algorithm that uses image perceptual hashing based on discrete cosine transform for coincident region detection to detect features during image stitching. The scope has been further reduced, and the non-matching areas between images have been removed, which greatly improves the speed and efficiency of feature detection. At the same time, a flexible, simple and fast search algorithm is designed for the search of coincident areas, and the algorithm is verified by experiments. Effectiveness and versatility.

In this paper, the fusion processing after image registration is studied. The smoothing algorithm based on the weighted fusion idea and the optimal stitching algorithm of dynamic programming theory are analyzed and tested to verify the effectiveness of the scheme. For the adjustment of the light balance problem, a proportional model between pixels of adjacent sequence images is introduced for optimization and adjustment, and a good experimental result is achieved. Aiming at the quality evaluation of the fused image, subjective and objective evaluations of the fusion result were performed according to commonly used image evaluation indicators, and a relatively ideal fusion effect was achieved.

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Data Availability

Data sharing is not applicable to this article as no new data were created or analysed in this study.

Conflict of Interest

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

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