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Applications of FAST Corner Detection in Kiwifruit Detection

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Abstract: The traditional kiwifruit quality evaluation method mainly relies on artificial visual inspection, which has strong subjectivity, long detection time, low efficiency and wrong judgment. In order to solve the problem of low efficiency and poor accuracy of feature detection, this paper proposes a fast feature extraction method for kiwifruit fruit based on FAST feature point detection algorithm. Firstly, the kiwifruit image was grayscale processed, the original image was grayscale processed, the gray map was denoised by the median filter, and then the kiwifruit fruit in different backgrounds was detected by the control variable method, and the points of feature detection were visualized, and it was concluded that the kiwifruit features in different backgrounds could be quickly extracted by using this method.

Keywords: FAST Algorithm; Median Filtering; Feature Detection; Kiwi; Fast Extraction.

1 Introduction

Image corner detection is the earliest In the 70s, it was proposed by experts and scholars related to images[1]Image inflection point research has always been a research hotspot, from the early Moravec, Harris SIFT, SURF and other algorithms are proposed[2]However, these algorithms still have problems such as large amount of computation, long time and low efficiency in feature image extraction, and there is a lot of research space in the accuracy and efficiency of feature extraction, and Rosten, E and T. Drummond proposed F in 2006AST feature point detection algorithm, This method is superior to other methods in terms of efficiency and accuracy[3].

While the FAST algorithm has high efficiency and accuracy in corner detection[4], but in complex kiwi images, there may be a large number of non-corner areas[5], which can interfere with corner point detection. Even if the corners in the kiwifruit image are successfully detected, how to extract the features from these corners that can effectively reflect the quality of the kiwifruit, It's a conundrum. At present, YOLOv5s is used to detect kiwifruit fruits[6], the kiwifruit detection model based on the adaptive genetic algorithm, for the detection of the detection of corner algorithms Harris Corner Detection Algorithm[7]The core of the project is that the local window moves on the image to determine whether the grayscale has changed greatly. If the grayscale values within the window (on the gradient plot) all vary greatly, then there are corners in the area where the window is located. The SUSAN algorithm has high computational efficiency[8], but it is sensitive to the presence of noise, which may reduce its detection effect in the presence of noise images, The advantage of the SIFT algorithm is that the extracted features are invariant to both rotation and scale, and to noise[9], angle changes, and lighting changes have good robustness. However, the algorithm also has some shortcomings, such as high computational complexity and insufficient sensitivity to edges and textures[10].

In order to solve the problems of low efficiency and low accuracy of feature extraction, this paper proposes a FAST-based corner detection method to achieve rapid extraction of kiwifruit feature points through denoising processing. Detection of kiwifruit by the FAST algorithm.

2 The FAST Algorithm Was Used To Detect The Corners Of Kiwifruit

The FAST algorithm proposed in this paper is to take each point in the image as the center pixel and take the value, if a pixel is quite different from enough pixels in the surrounding neighborhood, the pixel may be a feature point to extract the feature point. A circular range with a radius of 3 is selected as the neighborhood, with the pixel of the detection point P as the center of the circle and the 16 pixels on the circumference as I_{pi} the center.

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$$S_{pi} = \begin{cases} d & I_{pi} \leq I_p - n \\ s & I_p - n \leq I_{pi} \leq Ip + n \\ b & Ip + n \leq I_{pi} \end{cases} \quad (1)$$

In Eq.(1), middle I_p is the pixel value of the center point, I_{pi} is the pixel value of i consecutive points, i=1,2,3⋯, 16 threshold is n. if $S_{pi} = d$ or $S_{pi} = b$, then the pixels in the surrounding neighborhood are greater than or less than the pixel value of the center point, indicating that the surrounding neighborhood is brighter than the feature point or darker than the feature point, then the center point P is the feature point.

The original FAST corner detection algorithm needs to take 16 consecutive pixels in the window area near the center point , and take the difference between the gray value of these 16 points and the gray value of the center pixel. In general, I take 9 to work best.

Due to the need to carry out for each point Detection of 16 pixels, So Yes, The FAST corner detection algorithm is optimized to prioritize the detection of pixels at positions 1, 5, 9, and 13. If it doesn't meet the requirements is skipped, and the optimization improves FAST the computing speed of the corner detection algorithm, Improved detection efficiency.

2.1 Grayscale The Original Image

The data obtained in this paper are all color images, and the FAST algorithm can only process grayscale images, so this paper uses grayscale images to convert color images into grayscale images, the purpose of which is to simplify the matrix and improve the operation speed. The color of each pixel in the color image is determined by R, G, B three components, and the value range of each component is between 0-255, so that for the computer, a pixel of the color image will have $256*256*256=16777216$ a kind of color change range, and the grayscale image is a special color image with the same R, G, B components, and to the computer, the change range of a pixel is only 0-255 this 256 Seed.

After grayscale processing, the quality of the original image is improved, so that the image can display more details; improve the contrast of the image (contrast stretching); selectively highlight features of interest in the image or suppress unwanted features in the image; It is effective to change the histogram distribution of the image so that the distribution of pixels is more uniform.

2.2 Denoise The Original Image

In this paper, the median filter is selected for denoising, which can deal with nonlinear signals, effectively suppress the noise in the image through the sorting statistical theory, and replace the value of one point in the digital image or digital sequence with the median value of each point in a neighborhood of the point, so that the surrounding pixel value is close to the real value, and then eliminate the isolated noise points. In addition, a median filter is selected to remove stray noise points from the image without or to a lesser extent blurring the edges. This is achieved by sorting the pixels around each pixel and then selecting the median as the new value for that pixel. Therefore, the median filter does not change the edge information in the image during the processing process, which is very beneficial to protect the detail information of the image. The removal of Gaussian noise from the original image is not ideal. Because the distribution of Gaussian noise is normally distributed, and the median filtering is based on the method of sorting statistics, the pixel values around the average value of Gaussian noise may be quite different from the original pixel values. In addition, if the window size of the median filter is too large, it can also cause the image to become blurry. This is because details that are inside the window, but not noise, are also filtered by the median, which affects the quality of the image. Therefore, in this paper, the median filter binarization is selected to process the original image to effectively eliminate spurious noise and Gaussian noise.

3 Experiments And Discussions

3.1 Data Acquisition And Preprocessing

First of all, the kiwifruit images were selected, and several groups of comparison pictures were selected for the experiment, which included various types of representative pictures, including Jimei, Hayward, Dumb, Hongyang different varieties of kiwifruit, in addition

The kiwifruit in different light backgrounds was set, and a number of kiwifruit fruit pictures were selected. The following are some of the selected diagrams.

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FIG.2 ORIGINAL IMAGE

The raw data is grayscale, designated as M×N 2-D grayscale or binary image, and the following is the selected grayscale image.

FIG.3 SCHEMATIC DIAGRAM OF GRAYSCALE PROCESSING IMAGES

Because there is still some noise after the original image is grayscale processed, which affects the detection effect of the corners, this paper adds the median filtering and denoising nonlinear filtering technology to eliminate the spurious noise points on the kiwifruit picture to be detected without causing edge blurring to a lesser extent, so the median filter is selected to process the grayscale map, and the edge information is well retained in the image after median filtering, and the following is the selected picture after filtering.

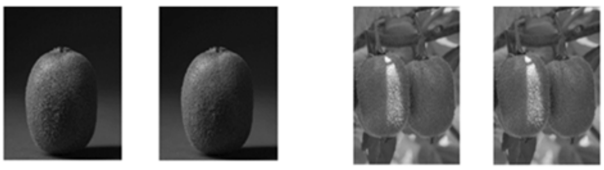

FIG.4 COMPARISON OF MEDIAN FILTERING

The median filter removes some of the salt-and-pepper noise and impulse noise, which removes the noise from the original image for the later corner detection, which is better for experiments.

3.2 *EXTRACTION OF KIWIFRUIT CORNERS OF DIFFERENT VARIETIES*

After preprocessing, the experimental images were detected by the control variable method, and the 100 strongest feature points were selected for display. The renderings are shown in Fig.

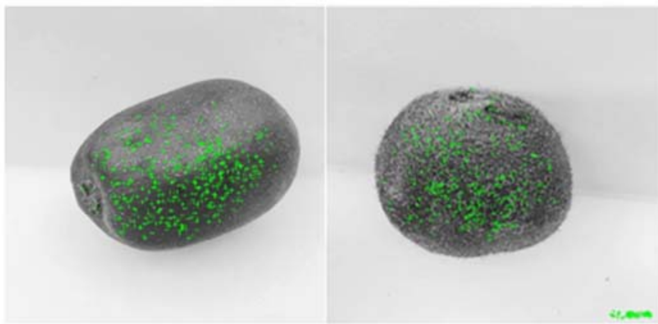

FIG.5 SCHEMATIC DIAGRAM OF FEATURE EXTRACTION OF A SINGLE KIWIFRUIT

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From the experiments of feature extraction, it can be seen that the surface feature extraction of different varieties of kiwifruit is more obvious. It shows good robustness.

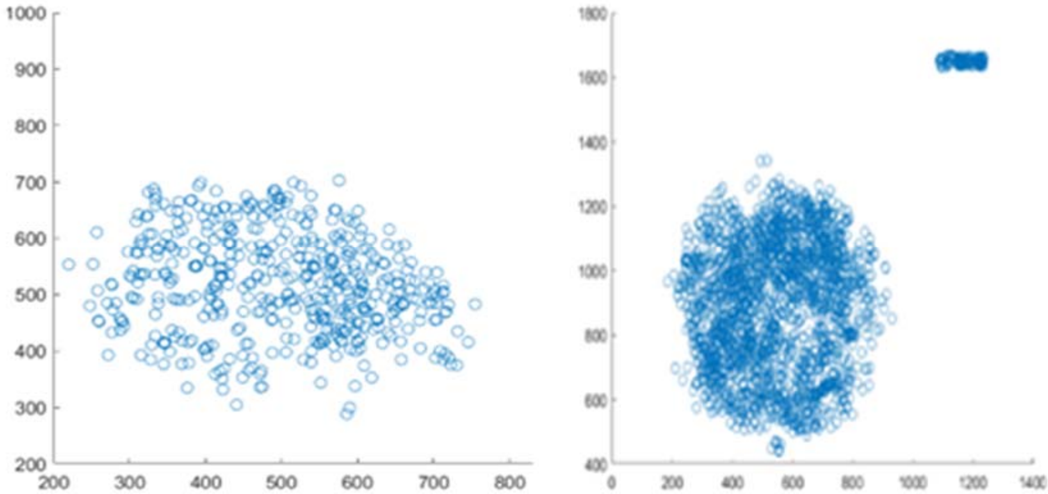

FIG.6. LOCATION OF CORNERS

The location of the feature points can be seen from the scatter points, and the extraction of feature points is accurate, and the experimental results show that the feature point extraction is fast and accurate. From the scatter plot, it is obvious that the location of the feature points is known.

3.3 KIWIFRUIT CORNER POINT EXTRACTION IN DIFFERENT BACKGROUNDS

The second group of selected data is kiwifruit with different backgrounds, including uneven light, different sizes, and kiwifruit cluster experiments, and the schematic diagram of feature extraction map extraction for some corner detections is given.

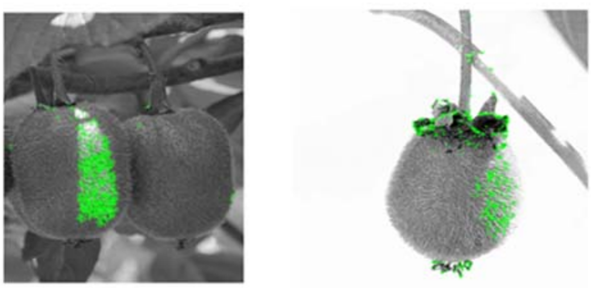

FIG.7: SCHEMATIC DIAGRAM OF KIWIFRUIT DETECTION UNDER DIFFERENT BACKGROUNDS

Through the above experiments, it can be seen that the FAST corner detection also shows fast characteristics for the detection of kiwifruit in different backgrounds, especially for the features under strong light, and it can be seen that the corner features show stronger robustness to the brighter part of the background.

Kiwifruit feature extraction in complex environments

The third set of experiments uses corner detection in a complex environment, and the experimental diagram is as follows:

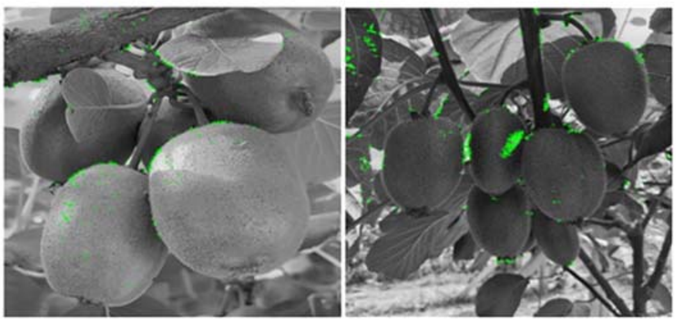

FIG.8 SCHEMATIC DIAGRAM OF DETECTION IN COMPLEX ENVIRONMENT

Through comparative experiments, FAST detection has a wide distribution of feature points in complex environments, and the extraction of diagonal points is more accurate. It can be seen that the corners in the image can be accurately identified by F AST against the background of multiple kiwifruits, and it can be seen from the experimental results that the detection points for the corners are concentrated in the contour.

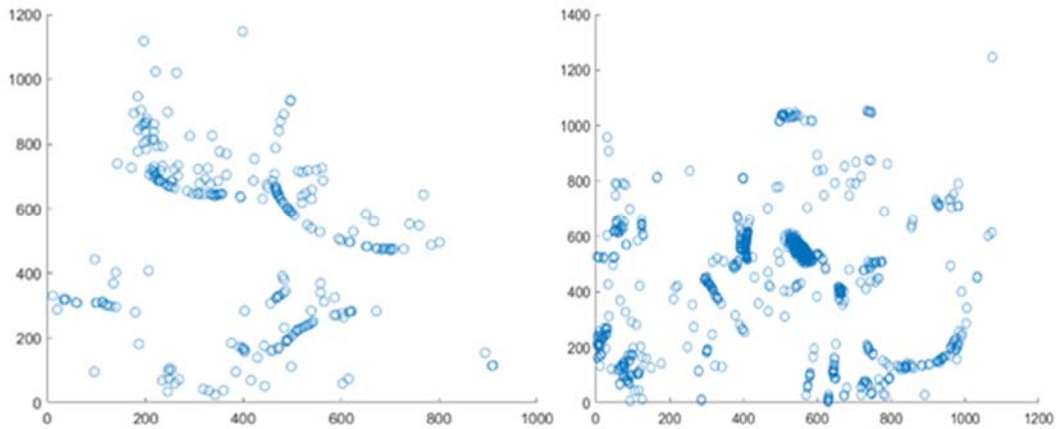

FIG.9 IMAGE LOCATION DISTRIBUTION

Through the above experiments, it can be seen that FAST corner detection also shows fast characteristics for kiwifruit detection in different backgrounds, indicating that FAST has high robustness and adaptability, and can detect objects under various light conditions and in different environments.

3.4 *SUMMARY OF THE EXPERIMENT*

Through the above experimental comparison experiments, it can be seen that FAST has high robustness in both dark and bright light, and can quickly detect multiple targets under the same light.

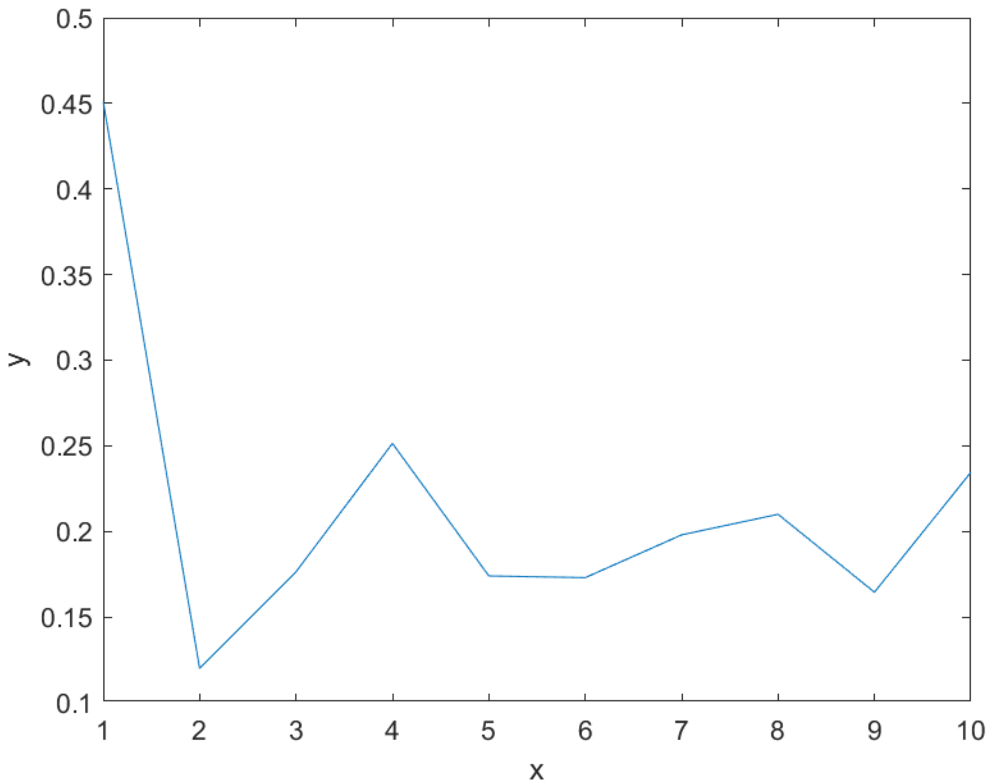

FIG.10 FEATURE EXTRACTION TIME LINE CHART

The abscissa x is the number of images, and the ordinate y is the elapsed time. From the above line chart, it can be seen that the detection time is extremely short, the highest one is extracted in 0.45s, and the rest is stable in about 0.2s, and the feature extraction can be carried out on the two-dimensional grayscale map. The FAST algorithm showed fast and accurate characteristics in the detection of kiwifruit. The superiority of this method is illustrated.

4 CONCLUSION

In the detection of different varieties of macaques, the FAST algorithm can realize the rapid detection of kiwifruit, and the corners of a single kiwifruit are concentrated on the observation surface. For kiwifruit with complex shapes and textures, the FAST algorithm can accurately detect corner features in complex environments.

When the lighting conditions change, the color and brightness of the kiwifruit will also change, and the feature points are concentrated in the brighter part of the image, and the FAST algorithm can quickly extract the image, which improves the detection efficiency and accuracy.

The FAST algorithm can extract feature points from kiwifruit in complex backgrounds, and can quickly and accurately detect corner features in complex environments in kiwifruit detection with complex shapes and textures.

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REFERENCES

[1]NIU Junli. Review of corner detection [J]. Science & Technology Wind, 2011, (20): 100-1.

[2]LIU Yuxia. Research on the improvement of FAST algorithm and its application in image visual complexity calculation[D]; Henan University, 2018.

[3]ROSTEN E, DRUMMOND T. Fusing points and lines for high performance tracking [Z]. Computer Vision, 2005 ICCV 2005 Tenth IEEE International Conference on vol2. 2005: 1508-15

[4]Chen Junling, Zhao Bangzhou, Yang Rongchang. Study on coupled vibration of wind turbine tower based on FAST [J]. Journal of Solar Energy, 2023, 44(10): 353-61.

[5]ZHAO Fuqun. Image Denoising Algorithm Based on Improved Median Filtering [J]. Computer and Digital Engineering, 2023, 51(2): 292-5,444.

[6]LI Xiaolin, WANG Fugang, ZHANG Pengfei, et al. YOLOv5s Algorithm Optimization Based on Multi-scale Feature Extraction [J]. Computer Engineering and Science, 2023, 45(6): 1054-62.

[7]Wu Xueli, Ding Xue, Meng Fanhua, et al. Double-threshold Harris Corner Detection Algorithm [J]. Journal of Hebei University of Science and Technology, 2013, 34(4): 330-3.

[8]Wen Yangtian, Li Zheng, Wu Zhongguang. Image Registration Based on SUSAN Algorithm [J]. Journal of Computer Applications, 2006, 26(10): 2380-2.

[9]ZHANG Yubing, LUO Qingshan, ZENG Guihua. Real-time tracking of part-based objects [J]. Computer Engineering and Applications, 2008, 44(7): 69-71,7.

[10]Fu Yongqing, Song Baosen, Wu Jianfang. SIFT Algorithm for Edge Classification [J]. Journal of Harbin Engineering University, 2010, 31(5): 632-6.