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Feature extraction and tracking based on visual information

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Abstract: At present, the widely used robots are mainly industrial robots, military robots and service-oriented robots. Because robots can replace human in some special fields to complete specific tasks, and robots have the characteristics of anti fatigue, high stability, etc., robots have been widely used in all walks of life and produced a considerable amount of economic performance. At present, robots with autonomous mobile function can be used in storage logistics, home service and other fields. In the unknown environment, robot can move autonomously is the prerequisite and the first condition for path planning and visual positioning. At present, the first problem to be solved in robot movement is to determine the robot's position first. It is a key step to predict and fine tune the robot's movement through the information captured by the sensor. Taking the main features of the image as the input, and then calculating the robot's position can effectively reduce the calculation amount and improve the calculation accuracy. The experimental results show that, for the given image, the processing technology and method in this paper can effectively reduce the time of image processing and enhance the robustness of positioning in the unknown environment.

Keywords: Feature extraction; scale invariant; corner; Shi Tomasi algorithm.

1. Introduction

In the process of robot's movement and information interaction with the external environment, it is necessary to determine its own position for path planning and navigation. Due to the complexity of the position environment, lack of illumination and other factors, the external information captured by the robot's sensors will be interfered[1],Therefore, the interaction between the robot and the external environment is affected. In this paper, the feature point extraction of the image in the indoor environment with insufficient illumination is studied, and the experimental simulation is carried out. The experimental results show that the method of feature

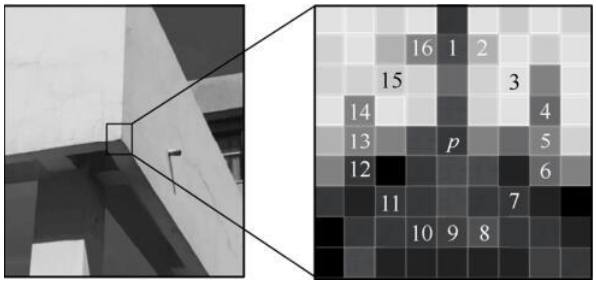
point extraction can be used to extract the key points in the indoor environmentwith insufficient illumination, so that the path planning of the robot in the location environment can be made [3] Become more convenient and fast.

2. Feature point detection

1.1 Fast feature point detection algorithm

The first problem to be solved in image matching is to establish the corresponding relationship between the images of the same object in different situations [2].Because the images of the same target at different time points, different positions and different illumination are not identical, it will affect the judgment and extraction of the target. Traditional matching methods usually select template to match, When the environmental factors change, the stability is not ideal.

Feature extraction is a basic link in image registration. The quality of feature extraction has a direct and important impact on the effect and accuracy of image registration 错误!未找到引用源。. Feature extraction is generally to extract representative points in the image, such as points that are not easy to be changed by light and disappear, and points with obvious gray changes, such as points at the edge or bright points in the dark area.Fast corner detection [11]It is a fast corner detection method. The detection method of this algorithm refers to first selecting a pixel point as the center point in the image to be processed, and constructing a circular area with the pixel point of the center point 错误!未找到引用源。, Compare the pixel value of the selected center point with the gray value of the pixel point on the circumference one by one. If there are quite a lot of gray difference values smaller than the set threshold value, then the selected pixel point is determined as the corner point, otherwise, continue to search for other pixel points. As shown in Figure 1-1:



Fast algorithm template diagram 1-1

A undetermined pixel is judged by calculating the fast corner response function:

$$N = \sum_{X \forall (CIRCLE(P))} \left| I(x) - I(p) \right| > t \tag{1}$$

Where I (x) is the gray value of all pixels x on the circumference, I (P) is the gray value of the selected target pixel, and t is the threshold value set according to the required requirements.

Through this response function [4]Then, the number of pixels n satisfying the

response function on the circumference can be calculated. If n is greater than the threshold value of the corner response function, then this pixel is considered as a candidate corner [10].In general, the threshold of fast corner detection is set to 12, which can effectively balance the detection quality and speed.

There are still many pseudo corners after candidate corner selection, so non maximum suppression must be performed to eliminate redundant pseudo corners, Avoid corner clustering. Define score function according to required objective:

$$V = \max\left[\begin{array}{l}\sum_{x\in S_b}\left|I_{p\to x}-I_p\right|-t,\\ \sum_{x\in S_d}\left|I_{p\to x}-I_p\right|-t\end{array}\right] \tag{2}$$

among:

$$\begin{cases} S_b=\{x|I_p>I_p+t\} \\ S_d=\{x|I_p<I_p+t\} \end{cases} \tag{3}$$

Perform non maximum suppression After that, the final corner is the maximum score in the local window.

The specific steps of corner detection are as follows:

Step1 First, check the four pixels with the number of 1, 5, 9 and 13 on the circumference of the target pixel. If the gray difference between at least three of the four pixels and the target pixel is greater than the set threshold value, then the pixel may be a corner point, and continue to check the next step, otherwise check the next pixel;

Step2 Calculation of corner response function value for pixels that may be corner points;

Step3 Set the threshold according to the required requirements. If the corner response function of the pixel is greater than the set threshold, it will be regarded as the candidate corner, otherwise it will be non corner;

Step4 Calculate the score value V of all candidate corners and perform non maximum suppression to get the final corner.

1.2 Shi Tomasi feature point detection algorithm

Shi-Tomasialgorithm[13]It is an improved algorithm of Harris algorithm, which is used to detect the points in the image where the gray value changes dramatically in all directions, and the points with maximum curvature on the edge curve. In this algorithm, the first derivative is introduced to calculate the change of gray level of the image after the local small window moves in each direction in a small amount 错误!未找到引用源。 .The basic idea of this algorithm is that if there is little gray change along any direction, then the small window is in the flat area of the image; if there is little gray change along a specific direction, and there is great gray change along the direction perpendicular to it, then the small window is at the edge of the image; if

there is great gray change along any direction, then The small window is at the corner.

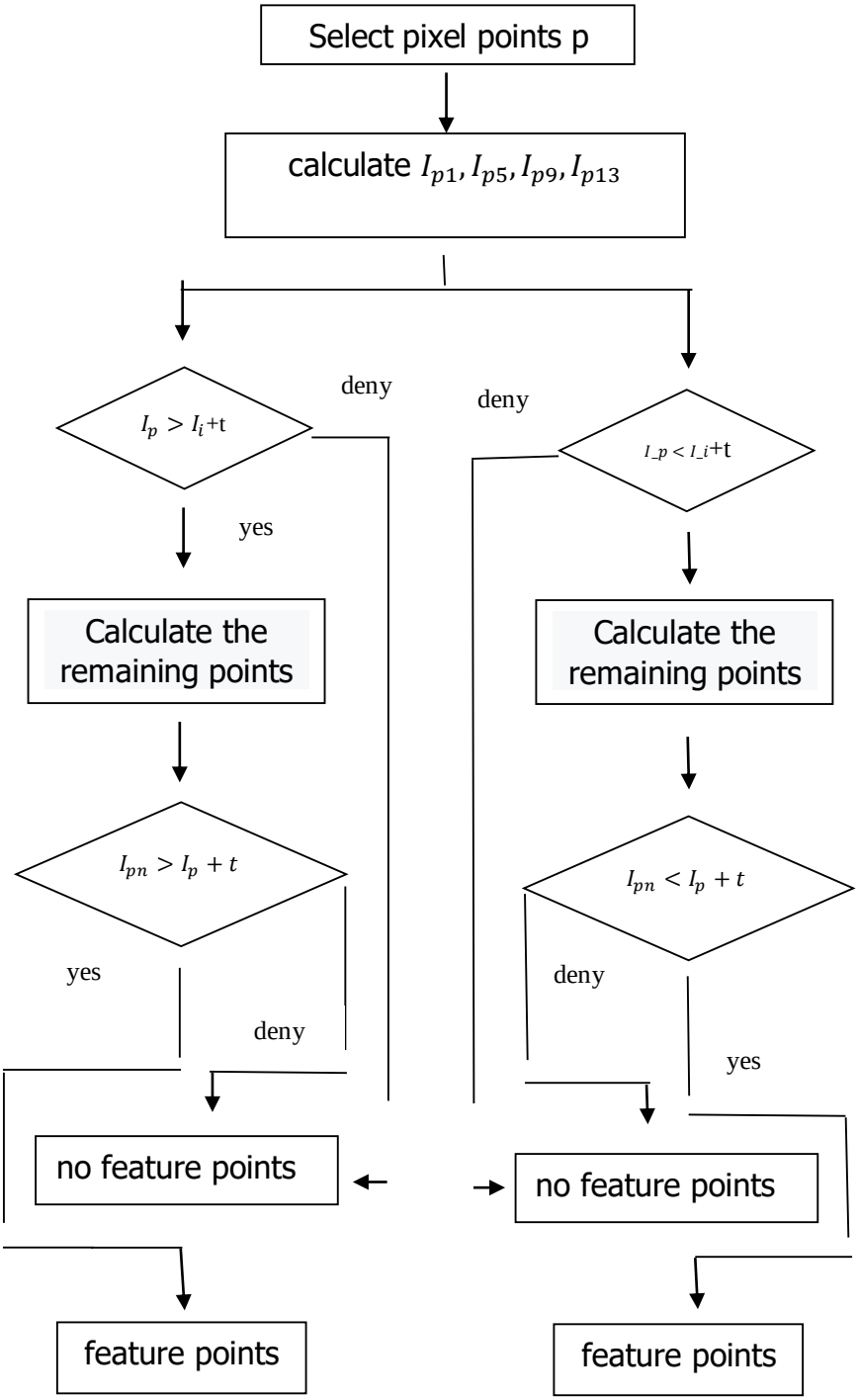


Figure 1-2

$$E(x,y)=\sum_{u,v} w(u,v)\left[I(x+u,y+v)-I(u,v)\right]^2 \tag{4}$$

The window function w (U, V) is represented by Gauss function, whose expression is:

$$w(u,v)=\exp(-(u^2+v^2)/2\sigma^2) \tag{5}$$

Expand equation (4) and omit higher-order terms:

$$E(x,y) \approx [x,y] M [x,y]^T \tag{6}$$

among:

$$\mathrm{M} = \exp(-\frac{u^2+v^2}{2\sigma^2}) \otimes \begin{bmatrix} I_x^2 & I_x I_y \\ I_x I_y & I_y^2 \end{bmatrix} = \begin{bmatrix} A & C \\ C & B \end{bmatrix} \tag{7}$$

The flow chart of feature point extraction of the algorithm is shown in the figure:

Where LX and ly represent the gradient value of image gray in X and Y direction respectively. Define corner response function as:

$$\mathrm{R} = \min(\lambda_1, \lambda_2) \tag{8}$$

There are two eigenvalues of and matrix m respectively. If the R value obtained at a certain point is greater than the preset threshold value and the local maximum value is obtained in its neighborhood, then the point is the Shi Tomasi feature point [9].

1.3 Improved orb feature point extraction algorithm based on adaptive threshold

In traditional methods, the threshold value is set artificially, and the threshold value is usually a certain percentage of brightness. In this way, all pixels on the circumference need to be set according to the fixed threshold value and the central pixel point [8]Compare,Then the non feature points can be excluded, and the amount of calculation is large. Because of the change of illumination, the brightness of the image collected by the vision system will also change,This will lead to the phenomenon of false extraction and false elimination. Therefore, if a fixed threshold is used, it can not take into account all the regions of the whole image, and it is difficult to achieve the desired effect. Dynamic local threshold can be used to solve this problem [5]ofMethod,With the idea of adaptive threshold segmentation, different pixels in the image can be set to different thresholds.

The selection method is to define the threshold value for each pixel separately t:

$$\mathrm{t} = \sigma * (I_i - L_{\max} - L_{\min}) \Big/ L_a \tag{9}$$

among, $\mathrm{L}_{\max}$ Is the brightness of the pixel with the highest brightness on the circumference; $L_{\min}$ Is the brightness of the lowest pixel; L_a for removal $L_{\max}$, $L_{\min}$ The average brightness of the remaining pixels after that. among, $\mathrm{L}_{\max}$ Is the brightness of the brightest pixel on the circumference; $\mathrm{L}_{\min}$ is Brightness of the lowest pixel; L_a Is the average value of the brightness of the remaining pixels after removing the two pixels with the maximum and minimum brightness. because $\mathrm{L}_{\max}$,$\mathrm{L}_{\min}$, L_a Both are not fixed values, so t is a dynamic local threshold.

Because of orb algorithm [12]It does not need to compare all the pixels in the center of the circle, so it can reduce the amount of calculation. At the same time, it can

quickly filter by detecting the pixels in the circle through the interval [6].

3. Experiment

it can be seen that all corners detected by the Shi Tomasi algorithm are ignored, and then all corners qualified by the quality level are arranged in descending order according to the quality of corners. First, select the corner with the highest quality, delete the corner within the Euclidean distance, then select the corner with the second highest quality, and repeat; finally, select the corner with the second highest quality The orb algorithm does not need to compare all the pixels in the circle with the center pixels, so it can reduce the amount of calculation. At the same time, it can filter the pixels in the circle quickly by detecting the pixels in the interval.

4. Epilogue

Because of the complex indoor environment, it is necessary to extract the key features of the image to be detected, which can reduce the amount of calculation and processing time. From the experimental results, we can see that fast algorithm can not reject many candidate points by judging the four corner points through the surrounding area, at the same time, it will result in multiple feature points crowded together, and threshold selection will also result in the results Great impact. When orb detects the feature points, it will first find a special area from the image as the target area, then search and detect in the target area, so it improves the speed, but there are still a lot of feature points clustering. Shi Tomasi algorithm makes the corner point move slightly in any direction, which causes the direction and amplitude of the gradient image in this area to occur very much With large changes, corner points can be found from the local maximum corresponding pixel points in the gradient. From the experimental results, we can see that the speed of the found feature points meets the requirements, and the distribution is relatively uniform.

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