Research on CCD Image Feature Extraction Algorithm Based on MATLAB

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***Abstract*—Based on the combination of 2D mobile platforms and CCD, an automatic control procedure is developed in the programming environment of VC+ + 6.0 system, which can accurately control the location of the collection each time, realizing two modes of functions of saving the image of light intensity distribution of the specified location and saving the corresponding gray values of light intensity distribution of the specified location. Then, the obtained CCD Image is stitched and data analyzed. Different algorithms are used to extract the bright spots and lines in the CCD image, and the actual distance between two lines is calculated, based on the extracted data, the composite image after extraction of bright spots is mapped. Finally, the advantages and disadvantages of the algorithm is analyzed and discussed.**

Keywords: MATLAB; CCD Image; Image Extraction; Gray segmentation

I. INTRODUCTION

Charge-coupled device CCD (Charge Coupled Devices) image processing has been a hot issue in the field of computer vision research. Especially after the successful development of high -resolution CCD station, it is widely used in high-definition digital cameras, digital cameras and other digital consumer products and remote sensing, astronomical measurements, non-contact industrial measurement and optical image processing and other fields [1-4]. CCD image processing system includes a CCD array, the analog front end AFE (Analog Front End) and a digital processing module, in which, CCD image processing system is an important analog module. CCD image processing method will directly affect the accuracy and precision. Therefore, CCD image processing has become a research focus in the fields of high-definition image processing, computer vision and microelectronics. There

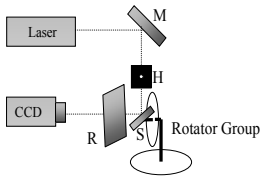

FIG. 1 LIGHT EXPERIMENTAL SCHEMATIC DIAGRAM OF REFLECTOR OF DIFFERENT ANGLE

are many CCD image processing methods: such as removing spurious points [5,6] , image smoothing [7] , edge detection [8] , image transformation [9] , enhancement, segmentation [10] and the image edge extraction [11] , etc. . In this paper, algorithm and its application on image segmentation in the CCD image processing based on MATLAB are studied. The image segmentation is the process in which the image is divided into several specific, and the unique areas and the target of interest is extracted. Image segmentation is the key of the image analysis, and the basis of the image expression.

II. ACQUISITION OF CCD IMAGE.

CCD Image used in the paper is a light reflection experiment with different reflector dips designed to solve an optical problem. The experiment device schematic diagram is shown as Fig. 1.

A bunch of laser reflected by the reflector M is shown on the reflector S through a keyhole H. The reflector S is put on a set of 3-D turntable made of two turntables. One of the turntables is placed horizontally which can turn in a horizontal direction while the other is placed vertically which can turn in a vertical direction. The incident angle of laser is controlled by the horizontal turntable and the dip of reflector is controlled by the vertical turntable. The receiving screen R made of two ground glasses is used to receive reflection from Reflector S. CCD(Panasonic WV-BP310, 4.8×3.6 mm, 768×576 pixels) is for recording the position of bright spots on the receiving screen R. first of all, the horizontal turntable is employed to adjust the incident angle to 40°, then the vertical turntable is regulated to make reflector S be perpendicular to the ground, that is, the dip φ is 0°, and the positions of bright spots are recorded on the receiving screen by CCD. Keeping the incident angle unchanged, many a picture of reflected bright spots will be captured under the condition of same incident angle and different dips by adjusting the vertical turntable carefully to increase the dip of the reflector S. Then adjust the horizontal turntable so as to change the incident angle, so the pictures of reflected bright spots can be obtained at different incidental angles and different dips of the reflector. CCD Image is a colored 24 bit RGB image with BMP format and 768*576 pixels. Fig. 2 displays the JPEG format image of CCD image of some reflected bright spots composed by PHOTOSHOP with size transformation, compression and strengthening

bright spots when incident angle is 45°, in which the white represents the position of bright spots. According to the requirement, the pixel position of bright spots needs calculating in every picture.

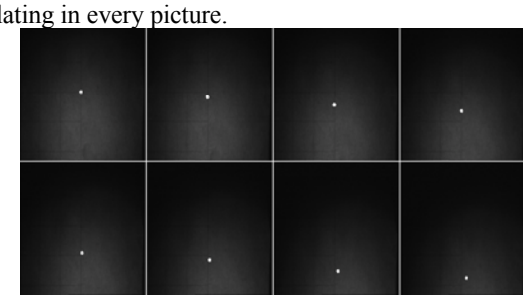

FIG. 2 SYNTHESIZING EFFECT DIAGRAM OF PART OF THE CCD IMAGE OBTAINED FROM EXPERIMENT

III. ACQUISITION OF IMAGE BRIGHT SPOTS BASED ON MATLAB

Through experiment, a set of CCD image files at every fixed incidental angle are extracted, they are made of 19 pictures all with BMP format,768*576 pixel and color RGB mode. There is a common characteristic in these pictures: there is only one bright spot in the picture and all are in black background. Their difference lies in the different positions of bright spots in the picture. For the sake of convenient dealing, firstly, the original pictures are transformed into black-white two value ones by MATLAB and then the picture is turned into images matrix based upon the principle of MATLAB recording image. Since there is one and only one bright spot in the black background of the original picture, the value of bright spot zone is bigger than that of the rest black background, which can be testified by the IMREAD function of MATLAB. Thus, in essence, the acquisition of bright spot is to obtain that of the maximum value in the matrix. Considering the bright spot is not strictly the spot in mathematics, so it is needed to calculate values within the bright spot zone so as to ensure the acquisition of the brightest position of the image. This method can be applied to the acquisition of the position of bright spot in every picture because of their difference positions of the bright spots in the picture. In the end, all the bright spots are demonstrated together in one picture, its composed effect is shown as Fig. 3, in which, red spots are generated by exaggerating MATLAB's acquired spotlights and filling them with red color. The big spot in the center shows the position of central bright spot when the dip of the reflector is 0.

IV. CALCULATION OF THE DISTANCE BETWEEN ADJACENT LINES BASED ON MATLAB

From the CCD image given as Fig. 2, it is obvious that there are deep black lines which are both horizontal and vertical in the left half part of the picture. According to the requirement, it is imperative to extract the positions of lines in each picture and calculate the distance between adjacent lines. As the background of the picture is black and the extracted lines are deep black as well, so if they are acquired directly as bright spots by simply transforming the color image into black-white two value image, the visual effect will not be apparent, which can be proved by the IMREAD function of MATLAB. Therefore it is necessary to think about other ways to handle the picture. Then it is needed to employ the mathematic idea of acquiring extrema in certain zones, which is often used in the advanced mathematics, for squeezing the pixel positions of deep black lines.

It can be found through observing the red bright spots and deep black lines in Fig 3 that each of lines is between every two red bright spots. As vertical coordinates of red bright spots have been calculated as above, they can be used to get the most approximate vertical coordinates of lines. In this way, the nearest vertical coordinate of every line can be worked out, afterwards, it is practical to calculate the difference between every two lines and average it. In the end, the distance between two lines can be figured out. The key of the whole squeezing calculation is to choose a suitable threshold value for the aim of strengthening squeezing effect. After thorough consideration, the average of the given zone is regarded as the threshold value, because the value of most parts of the deep black lines zone in image matrix is lower than the average, otherwise, the entire deep black background zone in pixel matrix is higher than the average, and different zones have different pixel averages. Then the horizontal is chosen as unit in the study area and the number of pixel values lower than the average in each horizontal line is counted up. The one with the most numbers can be looked as the pixel position of deep black line. Before calculating, it should be noticed by observing the picture that there is none of researched deep black lines in the right side. Thus, it merely needs focusing on the left side of the picture. Next, it is coded by MATLAB with the following process. Firstly, a black line should be chosen with its adjacent red bright spots for working out the horizontal range in the researched zone. For its vertical range, it can be set from 50pixel to 350 pixels. The reason why it chose 50pixel not 0 pixel at left endpoint is that the boundary of the picture is too dark to calculate. Besides, owing to there being a zone without deep black lines after 350 pixels, so there is no need to research, the right endpoint is set at 350 pixels. Moreover, the 350 value is the slight right movement of vertical coordinates of white bright spots, which have been calculated in the above. Not only can it assure acquiring the most picture zone as possible and making full use of the picture data, but also eliminating effects of unrelated factors to calculation as much as possible. In original files, the deep black lines in each picture are taken photography of the same object under the same condition, which is different from the former extraction of bright spots in pictures. It is necessary to calculate every picture for the acquisition of bright spots while it is only required to calculate one of pictures for that of deep black lines. The final result of this calculation is 135 pixels, that is, the distance of adjacent straight lines in the original picture is 135 pixels.

V. Analysis of Advantages and Disadvantages of Algorithms

Image extraction technology is an important preliminary process of digital image processing. It is an important image extraction technology. And it is also the most basic technique of the image processing. However, in the issues of image extraction, so far, a sound theoretical system has not been established. So most theoretical systems are targeted at specific issues. And the most appropriate method is adopted sometimes it will integrate a variety of methods. The methods used this paper will be analyzed in the following.

This paper is mainly divided into two parts: the extraction of bright spot in the image and the extraction of deep black line in the image, two different but not isolated methods are utilized; they are closely related to each other. Next, this paper specifically discussed them.

A. The algorithm of the extraction of black spots

The algorithms of the extraction of bright spots in the image can be specifically divided into two parts: that is to calculate the maximum and maximum neighborhoods. The idea of the method for calculating the maximum is comparing one by one, and the traversal method. The preparation of the method is simple, intuitive and understandable. But the efficiency of the algorithm is not high. If the number of the data to be processed is too large, it takes a lot of time. Or it needs a powerful computer to operate. For the method for striking neighborhood, mainly because bright spots on the image are not strictly mathematical points but on a smaller circular area, striking neighborhood is mainly for affirming that the value obtained previously in this paper is the unique maximum and excludes influence caused by other external factors, making maximum offset. This algorithm also successively traverses the entire image matrix. The preparation of the method is also simple, intuitive and understandable. But the efficiency of the algorithm is not high, increasing the time complexity. In addition, this algorithm needs to be given a value of a neighborhood in advance. Because the given neighborhood value is different, the results run by the algorithm will be different, which should be paid attention to. Algorithm for calculating the neighborhood is a supplement for the algorithm for calculating the maximum with the purpose to verify and ensure that the maximum value obtained is the only one. If the image matrix is too large when the maximum value is sought, the matrix can be divided in advance, and seek the maximum for each of the divided matrix obtained, finally, summarize and compare the results.

B. Algorithms of the Extraction of Deep Black Line

The algorithms of extraction of deep black line mainly draw lessons from the idea of striking the maximum in a given area of Advanced Mathematics. The mathematical method of Squeezing and basic statistical method of statistics are utilized to extract the data by calculating. The method is simple, intuitive, understandable, and easy to program, furthermore, it is commonly used, so it is easy to be promoted. The disadvantage is that when the algorithm is used, it is needed to estimate the required regional boundaries in advance. For the different boundaries, the results calculated may be biased. Result accuracy calculated by the algorithm is affected by the boundaries. However, multiple measurements can be used to obtain the average value, minimizing the impact of human factors at the most, improving the calculation accuracy of the results. But this may take more time.

C. Summary of Algorithms

The algorithms used in this paper are proposed for the specific problems this paper. They are not general; however, they have reference value for researching other issues. At the same time, some new methods and new ideas of image extraction technology are constantly introduced by many other researchers into the field. Image extraction technology is developing towards a more automatic, more accurate, more rapid and adaptive goal. With the development of computer technology and the application and improvement of a variety of new theories, image extraction technology will be constantly improved.

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