Study on the height measurement based on the image processing technique

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Abstract: It is difficult to realize the height measurement based on the image processing technique. In this paper, we study how to carry on the height measurement with one CCD camera. In order to reduce the influence of the lighting conditions in the environment, the near-infrared laser and filter were used. We tested our method with various materials. The experiments show we can get reliable results in our laboratory conditions. The further research and some verifications of our algorithms will do later.

Keywords: Image processing, Heigh measurement, Near-infrared laser

I. INTRODUCTION

Height measurement problem has a long history, and there are variety of measurement, some of these measurement also use the technology of image processing. It mostly use of mathematical computation with extra scale and multifarious algorithm of image processing, not only compute complexly but also is influenced easily, so influence the precision of measure. The following text will introduct how to carry on the height measurement with one CCD camera

II. The mechanism of measuremen

As illustrated, we make CCD camera and laser fixed, then we can get the length between camera and laser through precision measuring instrument. We also can get the value of angle between the centre line of camera and horizontal plane by measuring instrument. In the picture two black piece represent the reaction of height when the light emited by laser fired the measured object. The angle of α and β can be got through image processing, based on geometrical relationship we can calculate the h as the next formula.

$$h = l \times \tan(\theta - \alpha) - l \times \tan(\theta - \beta)$$



The picture depict the situation that CCD camera centre line and measured pixel of luminous beam are in the same plane. We call this plane for vertical center plane. There is another situation which camera centre line and measured pixel of luminous beam are not in the same plane. We mark the angle that between centre line and measured pixel as γ which we can get through image processing. We found a parameter L,make L=l/cos γ ,and then instead of h.Now we can Continue using this formula.

III. The principle of measurement

The light emitted by laser fired on the profile of a workpiece,forming a bright curve that is the profile of the workpiece.The bright points do not in a straight line because of curve profile of workpiece.Through the camera we can get the picture and then we process the picture.

In image processing, we use the algorithm of model conversion, edge detection, binaryzation and so on, above all we use of filter. This can greatly reduce the difficulty of image processing, simple the algorithm, shorten the computation time, improve the detection efficiency, and can obtain accurate and stable results. We already know the wide angle of camera, through image processing, we can get position relation of bright pixel and centr pixel, then find out the angle of α and β . According to formula (1), we can figure out height difference, and then get the profile.

IV. Experiment research

In the laboratory we build a simple platform, with a screwdriver handle to be tested. First we show the picture without filter; And then put the filter in front of the lens, the picture we get is as 2; The third picture is after processing. The effect of image processin as flows:



Without filter



Filter

After using filter, we will amazed: how a perfect picture. However this is not the final result we want, we must extract a line, a centre line of the luminous beam. Then we can get the position of every pixel in the line. In order to get α , β and γ , we must calculate the distance between measured pixel and centre line of the picture, which is not difficult. We can use this equation which is shown by matrix. We can achieve this equation in programming way, then we process these data that we have get about height. With these data we can get the profile easily.



After processing



$$\times \left(\begin{bmatrix} \tan(\theta - \alpha_1) \\ \tan(\theta - \alpha_2) \\ \bullet \\ \bullet \\ \tan(\theta - \alpha_n) \end{bmatrix} + \begin{bmatrix} \tan(\theta - \beta_1) \\ \tan(\theta - \beta_2) \\ \bullet \\ \bullet \\ \tan(\theta - \beta_n) \end{bmatrix} \right)$$

V. CONCLUSION

Image processing method to measure the height mainly includes two parts: hardware component and software component.It will increase the costs and working environment if we make hardware better only.And it will increase the processing time if use complicated algorithms.Now we use cheap equipment to meet the requirements of precision, and greatly reduce the equipment cost.However if we want to improve measurement accuracy, better camera will be used.

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