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Research in Embedded System about Image Measurement Based on Hough Transform

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Abstract: *With intelligent devicesdevelop faster and faster in today's society environment,people become more and more rely on these intelligent device. While image processing is an important means of intelligence,it has become one indispensable important means of intelligent control.As the application of image processing is more and more widely and the image processing technology is more and more stable, the image measurement is also more and more important in the industrial control scene. This article focuses on embedded platform and with third-party libraries of OpenCVto realize the image measurement, the embedded platform is low cost and processing speed is fast, which can apply to different work environment.*

Keywords: Hough, image measure,embedded,OpenCV.

I. INTRODUCTION

With the rapid development of the embedded field, and with the advantage of embedded platform is real-time, reliability, it gradually be taken seriously in the field of industrial control.As embedded processor performance rising, prices falling,it become more and more widely used in image process field, including from safety field, industrial monitoring to automated vehicle and auto safety, etc.

Image measurement is an important branch of computer graphics, which have effect on style of measurement.This article is based on the basic knowledge of computer image measuring to measure the position of filling barrel mouth.Now in the modern industrial automation production, automatic filling machine is the important constituent, but at present many enterprises still use semi-automatic filling machine which needhelp of artificial. For long-term operation filling toxic or strong corrosion liquid bring huge damage to workers health. In addition, semi-automatic filling or artificial filling rate will be influenced by human physiological rate limit, and the staff must be dressed in a thick protective clothes, with the long time single filling work will be very easy to cause physical fatigue, lowered the work efficiency, increase product loss, increase the environmental pollution of packed material and production, and as there is not monitor, it can't ensure the quality of filling, also it is easy to cause an accident. In addition, the cost is also a very important question, semi-automatic filling or artificial filling system needs a continuous overhead wage for workers. Nowadays filling barrel specification and size may be different, filling system can't realize a variety of specifications of the barrel filling, which need different machine to complete the work,itwill virtually increase the cost of the factory. And in the modern factory automation, in order to realize automation we need to use detection techniques, which is inevitable,such as displacement sensors, limit switches, etc., through the sensor’s signal feedback to realize automation processing. Using computer image measurement can avoid the occurrence of these problems, first of all, can avoid the risk of manual operation, and suitable for a variety of different kinds of filling barrel, and avoid to maintain the stability of the sensor frequently.

II. METHOD

The principle of Hough transform is to use global image features like edge and connect edge pixels to form a closed boundary, it converts the image space to the parameter space, describe each point in the parameter space to achieve the image edge detection and get the position of the shape. The essence of the Hough transform is coordinate transform, which transform the image coordinate to the parameter coordinate to make the results more recognition and detection. In this paper, what we use is application of hough transform in round detection, for now there are some methods about hough transform like classical hough transform-the original method of hough transform, improved randomized hough transform algorithm, but all of these is based on the classical hough transform method and do some improved.

Classical hough transform methods are mainly used as follows, first there is a round, which is preset like$(x-a)^2+(y-b)^2=r^2$, while (a, b) refers to the center of the circle, r refers to the radius. The x-y plane of the circle transform into a - b - r parameter space, which like $x=a+r*\cos\theta$, $y=b+r*\sin\theta$. Any point of the circle in the image space corresponds to a cone in the parameter space, and any three points in image space corresponding to the three cone which will come cross in one point, which is suitable for any three of the cone, that meanseach point will corresponds to some circles, and all of these circles will be repeat(FIG1,FIG2).so after we doing these circlesstatistics, the biggest times of the circle appear, the more possibilitycircle is what we asked.

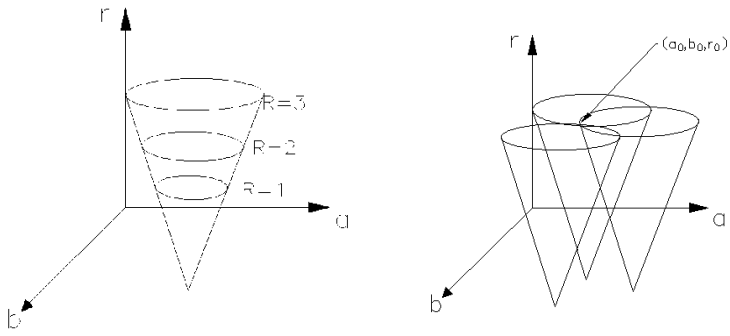

FIG1 Each point - coneFIG2Three point-Three cone

In the context of image processing, image edge points are detected, so to get the specific information of the round, we need to use hough transform under the ideas of classical method, to deal with the each point on the circle, which is Ballard put forward the thought of the generalized hough transform, starting from the basic definition and characteristics of the circle, deal with each point, a point could theoretically have many round, of course, we will set a threshold value, such as setting up a point of the radius of the circle between [r0, r1], so that all the points on the edge can be constructed with maximum probability of boundary point, the largest number of the judgment point is what we need to get the parameters of the circle in the end, that is to say, all the points on the edge of most likely by the parameters of the circle.This article is based on this idea to realize the test method, this method has the advantage of high accuracy, but defect is we need more computer resources to complete this calculate.

III. PLAN OF RESEARCH

The whole filling barrel measurement system includes three parts: the front part of bottle mouth image acquisition, the second is image analysis and processing parts and the last is equipment control.FIG3 is the schematic diagram of the measuring system:

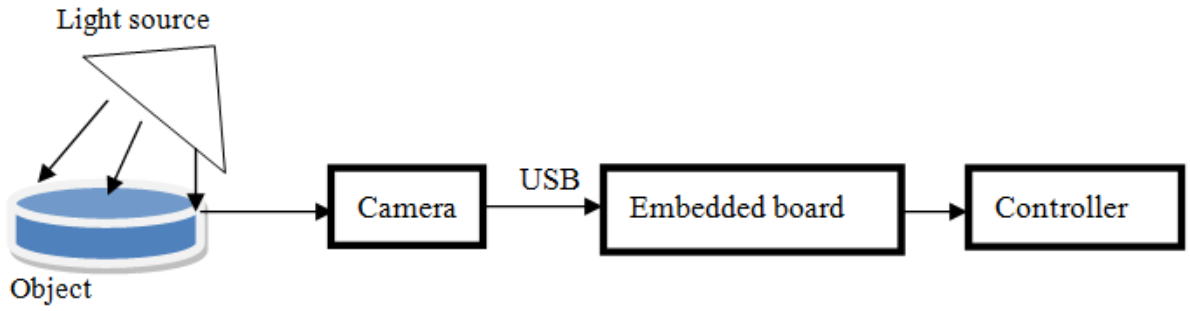

FIG3System ofmeasurement experiment

Measurement system mainly include industrial digital cameras, embedded processors and back-end control system.The front industrial camera capture the image of the container bottle, embedded processors do image processing, like image preprocessing and image edge detection, image measurement is realized by using the hough transform.Measurement result is based on image pixel unit, so after that we need to transition to the reality of coordinate system, like calibration of measuring coordinates, the camera calibration is one of the most basic of visual measurement, also is one of the most important work, the camera calibration is a process to get inside and outside the camera parameters, the camera internal parameters value is the basic parameter of imaging, such as the effective focal length, main point, scale factor, tangential lens distortion and other system error parameters, the camera external parameters means the camera relative to the orientation of the outside world coordinate system, mainly some coordinate transformation parameters.

The embedded platform is based on the TI –cortex-A8 platform for the control, embedded industrial control platform through USB interface to connect a camera, through the camera to obtain images which is need to deal with, the images through the USB transmitto the CPU for processing, the onboard program main use OpenCV to realize image processing.

OpenCV (Open Source Computer Vision) is a library of programming functions mainly aimed at real-time computervision.Originallydeveloped by Intel'sresearch center in Nizhny Nov-gorod (Russia), it wa s later supported by Willow Garage and is now maintained by Itseez. The library is cross-platform and fr ee for use under theopen-source BSD license.

IV. RESULT AND ANALYZE

Measurement results is (598,784), which is the position of the circle and the circle radius is 1 82(unit is the pixels), calibration is using the checkerboard of camera parameter calibration.Photograph chess calibration card, image processing of photos and pixels is used to analyze the checkerboard calib ration, such as the chessboard is 25cm*25cm, using matlab processing,measure every occupation of che ckerboard pixels, using proportional relationship (below) and measurethe radius of the circle.

$$\frac{Numbers\ of\ pixel\ in\ chessboard}{length\ of\ reality} = \frac{pixels\ of\ the\ object}{length\ of\ the\ object}$$

FIG4 Result of hough transform

Measure the perimeter of each pane in the calibration card, as a result of the calibration card deformation reasons (in paper print calibration card), take the uniform part of perimeter values, after sorting,taking the middle part of the average value.

Perimeter pixels corresponding to the actual length is100cm, according to the proportion of the value of the formula for the radius as follows:

R=182*(100cm/517.4286)=35.1739cm

So it can calculate the value of the diameter, which is d = 2*r = 70.3487cm

Actual use vernier caliper measured value is 69.65 cm.Error controls in 1.003%, basic can guarantee the accuracy of measurement.

V. CONCLUSION

After all the experiment is successful, which having realize the size measurement using the image process, the accuracy is in the acceptable range, but there are still some small problems,for example, the precision need to be improved.Using high precision calibration chessboard will be needed, which can lower the error.Image processing algorithms need further improvement, which can reduce the time of computer processing and improve the precision.