

Design of LEDges Technique for detection of Faults and Edges

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Abstract—In modern industries we need the technique to inspect the products very rapidly and find faults in the products so that we can distinguish the good products from the faulty products. Recently there are many techniques for machine vision but there complex algorithm and high initial cost makes it difficult to implement in the industries. In this paper efforts have been made to implement visual inspection of the product without complex algorithms and with low initial cost using image processing techniques. In this paper two methods for edge detection is compared and the results are displayed. This is done using matlab and modelsim software. In this LED is used to detect the edges clearly and due to the use of the LED, detection can also be done in the low light areas.

Keywords:- Edge detection, Image processing, LEDges, Visual inspection(VI).

I. INTRODUCTION

Previously in industries the manual inspection was used for inspecting the products. The disadvantage of manual inspection is that the humans can do work efficiently for not more than few minutes or hours, and due to this the quality of the products decreases. It is observed that human inspection are expected to have 70% of errors. To avoid this we use automated visual inspection method. In recent years, with the development of computer technology, digital image processing theory and method continuous improvement, the automatic detection technology to product without contact using has gradually become feasible. There are various uncertainties in the manufacturing process of the industries such as tolerance, defects, relative position, etc. Which can be resolved by vision sensing. In vision sensing the problem is how to match the technology to specific application in an optimal cost effective way. Machine vision inspection system has been successfully applied in many industries, for example, the integrated circuit production, the fruit and food quality inspection etc. In many industries such as Pharmaceutical, bear bottles, and companies where tubes and caps are used, there is need to check the condition of the tubes or bottles so that we may find the faulty products and can differentiate from the quality products. The bottles which are to be used need to be checked that there are no cracks no defects and in the tube caps it should be checked that there are no faults in the edges.

Even with the significance of VI for industrial automation, it still have many challenges. Many VI systems are based on complex algorithms and high cost of the hardware. This restricts the use of VI to certain domains. Thus the demand is increasing for the algorithms that are comparatively more simpler and more efficient which can be implemented in efficient embedded systems. Machine vision also be called computer vision. In computer vision the computer is used to realize man's visual function, or to use machine to replace the human eye to do judgements and measurements. The computer visual inspection(VI) has many applications such as inspection of engine parts, inspection of PCB's, food pack checks, etc. VI can be classified in four types based on the applications. The first type is Inspection of dimensional quality, which consist of finding Dimensions, shape, positioning, orientation, alignment, roundness, corners. The second type is Inspection of surface quality, which consist of Pits, scratches, cracks, wear, finish, roughness, texture. the third type is Inspection of structural quality or correct assembly, which consist of inspection of missing holes, slots, rivets, screws, clamps and presence of foreign object. And the fourth type is Inspection of accurate or correct operation (operational quality) which consist of Incompatibility of operation to standards and specifications. The inspection method in this paper is of first type. For developing any machine vision its application must be known according to the applications the machine vision can be developed.

II TYPICAL IMAGE PROCESSING STEPS FOR INSPECTION.

The image processing steps are divided in three levels of image processing. The first level or the low level consist of image capture and pre-processing as shown in the fig 1 below. In this process the image is acquired from the camera. most commonly used images for computer vision are the 2D images while there are many alternatives such as line scan imaging ,x-ray imaging ,3D surface imaging. The 2D visible light images have key divisions they are monochromatic vs. color, resolution, and whether or not the imaging process is simultaneous over the entire image. Though the 2 dimensional imaging solves the vast majority of machine vision application, there is increase in

use of 3D images for machine vision application in the industries. In VI the image capture is done continuously by moving the product or by moving the camera and the laser. The image acquired by the camera is pre processed to enhance the quality this is done by using median filter which reduces the noise in the image.

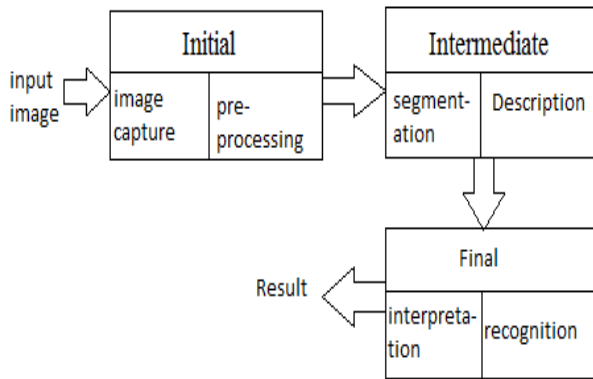


Fig 1-Typical image processing steps for inspection.

The second level is intermediate level which consist of segmentation, and description. In this the image segmentation is very important and complex operation. In image segmentation the required part in the image or the region of interest (ROI) is identified and then represented in terms of pixels or edges. The high level processing is responsible for image recognition, and finally, its interpretation indicating if the object under inspection is within or is not within the acceptable standards for the industry.

III. SOBEL EDGE DETECTION

The Sobel operator, which is used in image processing and computer vision is sometimes also called Sobel Filter, for detecting the edges present in the images, and generates an image which shows the transitions and edges. technically, sobel operator is a differentiation operator, by which approximation of the gradient is computed of the image intensity function. The output of the sobel operator is the norm of the vector or the corresponding gradient vector at each point in the image. In sobel operator small, integer valued, and distinguishable filter in horizontal and vertical direction is convolved with the image and is therefore relatively inexpensive in terms of computation. For high frequency variations in the image, The gradient approximation produced by the sobel operator is relatively rough. G_x and G_y are two images which at each instance contains the horizontal and vertical derivative approximations. It is a way to avoid having the gradient calculated about an interpolated point between the pixels which is used 3 x 3 neighborhoods for the gradient calculations [7]. The magnitude of the sobel operator is given by

$$G = \sqrt{G_x^2 + G_y^2}$$

where the G_x and G_y are the sobel masks given by

$$G_x = \begin{bmatrix} -1 & 0 & 1 \\ -2 & 0 & 2 \\ -1 & 0 & 1 \end{bmatrix}$$

$$G_y = \begin{bmatrix} -1 & -2 & -1 \\ 0 & 0 & 0 \\ 1 & 2 & 1 \end{bmatrix}$$

the G_x is increasing in the horizontal direction that is from left to right so it is called as the horizontal mask. and the G_y is moving downwards so it is called vertical mask. In this edge detection the pixel values are obtained by the neighboring. The advantages of sobel operator is its simplicity and the disadvantages are sensitivity to the noise and inaccuracy.

IV. CANNY EDGE DETECTION

The Canny Edge Detection Algorithm consist of following Steps:

Step 1 consist of Smooth the image with a Gaussian filter. As the edges in the images gets easily affected by the noise so avoid interference of the noise in the image the Gaussian filter is used.

Step 2 consist of the finding the intensity gradient of the image and orientation using finite-difference approximations for the partial derivatives.

Step 3 consist of Applying non maximum suppression to the gradient to get rid of spurious response to edge detection magnitude.

The function of Canny edge detector is to approximate the operator which optimizes the product of signal-to-noise ratio and localization.

The advantages of the canny edge detections are, finding of errors is effective due to the smoothing concept. another advantage is due to the non maximum suppression method the signal to noise ratio is improved and another advantage is that in an noisy images the edges are detected clearly due the thresholding method used. The disadvantages associated with canny edge detections are gradient calculation computation for angle of suppression generation and the major disadvantage is its complex computation due to which the time consumption is more.

V. LEDges

LEDges is the technique in which the edges of the images are found out with the use of LED and edge detection techniques. The name is LEDges because using the LED the edges are being identified. Fig 2 shows the processing steps of LEDges.

The inspection type in the LEDges technique is dimensional which consist of finding Dimensions, shape, roundness, corners. The ledges is described in four steps as presented in Fig 2. The first step is image capture in

which the object is illuminated by a high power light source the light source used is the LED and then the image is captured so that the required area is highlighted and as the intensity will be more while the background and shadows will be of lower intensities. The camera used for this is the simple digital camera to reduce the cost. The process of image capture is done by using Matlab software

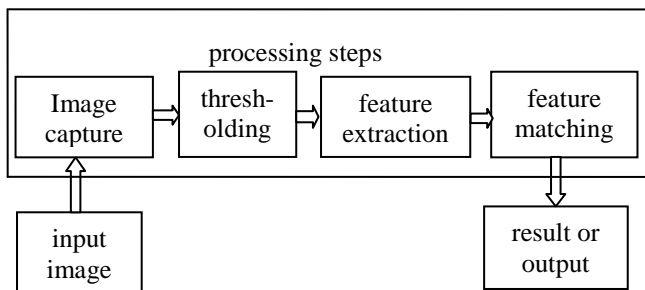


Fig.2 processing steps for LEDges

Due to the first step the second step can be easily performed as the image obtained can be easily segmented in two parts or two levels of different intensities one with lower intensity region representing the background or the shadows and second is of maximum intensity indicated by colour white which represents the lighted areas. The third step is feature extraction in which the output of the thresholded images is represented by its edges and described as a signature. Each edge is represented numerically in terms of the intensity level of the pixel at that point. The Edge detection of a digital image consist of identifying the points in the digital image using some of mathematical methods at which there is sharp change in the brightness of the image or there is discontinuities. The edges are termed as the points at which image brightness changes harshly and are generally organized into a set of curved line segments. The edge detection is done by the sobel and also by canny and the values are of the thresholded image. This is done by using modelsim software and coding is done in the VHDL format so as to make the use of codes for FPGA kits.

In Feature extraction the large set of data is reduced and only required amount of resources to describe a large set of data is maintained. In the process of analysing the complex data the major problem associated is the number of variables involved. When the large number of data is analysed the amount of memory required and the computation power required is generally more. The extraction of the features is the method to reduce the power and memory use for the image while still describing the data with sufficient accuracy.

The last and final step is the feature matching that is comparison of the features extracted test image with the features extracted standard image. If the features of the test image is similar to the standard image then there will be no edges in the output images and if there is change in the test image compared to standard image then the output will show the edges of the defective image . The output of the signature generated is a binary flag that

indicates whether the object is a good one or there is any defect on its edges. The overall process includes (i) The hardware required for the process, (ii) computer modeling of the of the first two step of LEDges using the matlab software, (iii)computer modeling of the last two stages of LEDges using modelsim.

VI .Results

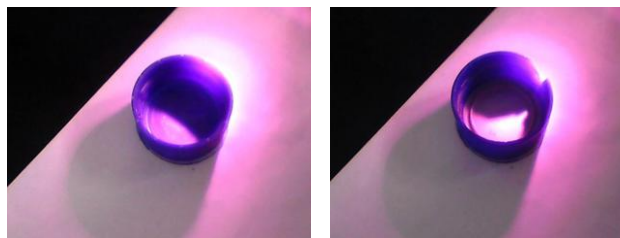


Fig.3 Input reference image

Fig.4 Input test image

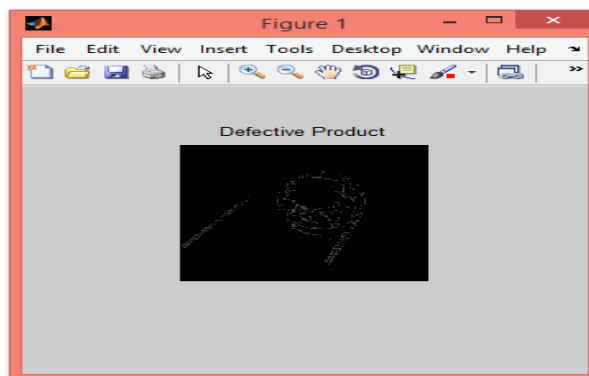


Fig.5 Edges of the defective images using sobel operator

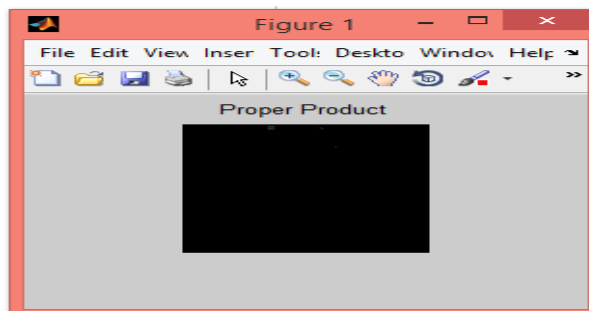


Fig.6 Output of proper product using sobel operator

Fig 1 and Fig 2 shows the input reference image and the test image which is defective. If the product is defective then the output will be the edges of the defect means wherever there is difference in the edge there will be a white pixel showing the defect. And if there is no defect then the output will have not have any white spots and the complete output will be black. As the edges detected are not so clear so the in the next step canny edge detection is used to implement and find the edges more clearly.

Fig 7 and Fig 8 shows the input reference image and test image respectively. Fig.9 shows the output using

canny edge detection. The output for proper product will b



Fig.7 Reference image

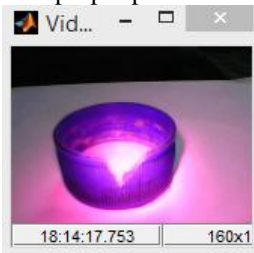


Fig.8 Test image

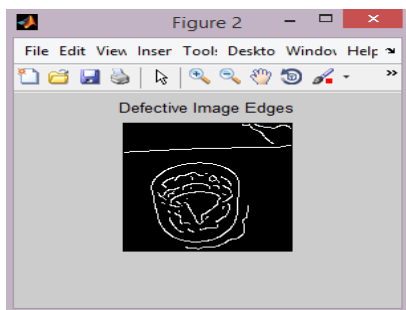


Fig.9 output using canny edge detection

VII. CONCLUSION and FUTURE SCOPE

Here the edges using sobel as well as canny are detected and the output clearly indicates that the use of

same as the sobel operator.

canny for edge detection for finding out the faults is more better than the use of sobel operator. The time required for inspection is few milliseconds and to improve the inspection speed the use of FPGA can be done.

VIII REFERENCES

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