Some Technique for an Image of Defect in Inspection Process Based on Image Processing

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***Abstract*—Image that referred to digital image consists of different types of noise. The quality of an image is complicated concepts, largely subjective and many applications dependent. In industrial environment, a good quality of image helps the inspectors achieves to investigate damage surface (defects) of products more effective and accurate. The study shows the fundamental of image processing. In this paper, some technique for image processing presented. The study included the types of filtering method.**

***Index Terms*—digital image, part inspection, image processing**

I. Introduction

Many of today's manufacturing industry received high customer demand. To ensure customer satisfaction, companies have to provide a quality product. It handles all phases of production output, which enables the production quality of the Company remained at the level of the best world standards. In addition, companies need to ensure that the product satisfies the customer by providing quality requirements. Continuous quality control is set in all the productive chain links [1].

Generally, inspection is an evaluation or examination of the products and parts. It involves of characteristic, gauge, measurement and test regarding on their functions and requirements [1], [2]. The output often been compared with Standard Inspection Procedure to ensure the consistent checking of the products and enable to achieve customer's need [2].

Visual inspection is a necessary process used by inspectors to exceed the high quality level of products in industrial environment. Nowadays, automated visual inspection system often being used compared to human inspection view or checking as automated inspectors system are always consistent and effective [3]. Image of products captured by the automated inspector were identified the contents consists in the image. The feature extraction of the image were investigated as to recognize the types and factors of the defects occur [3], [4].

Image processing basically improve the quality of image as to helps inspectors get the accurate and clear image for the inspection process. In addition, it can contribute benefits in industry to control the quality of products and exceed the customer expectations [2]. Some example of defect detect on testing image during inspection process shown in Fig. 1.

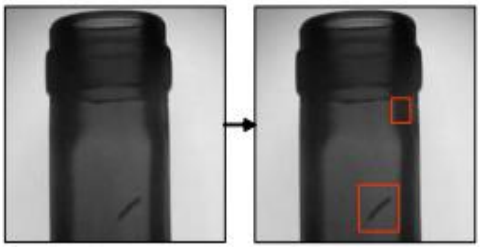

Figure 1. Test image during inspection process and their corresponding detection [3]

According to [5], defects can be identified using detail matrices which consist of median, max and min points.

II. Fundamental of Image Processing and Analysis

The main objective of image processing and analysis is to enhance digital images and extract information from them. Besides that, it allows automatic or semi-automatic identification, classification or characterization of objects and patterns [6]-[9]. An image is a subset of a signal that generally conveys information about the behaviour of some phenomenon's physical system or attributes [10].

Moreover, it produced a variety of physical devices includes of video cameras, scanners, ultrasound and etc. An image could denote luminance of objects in a scene, the absorption characteristics of the body tissue, the radar cross section of the object, the temperature profile of the region or the gravitational field in an area [11].

Fundamentally, an image is a 2-Dimensional light intensity function where and are spatial coordinates and the value of at is proportional to the brightness of the scene at the point. Image processing is multiuse process that can be use in varied field applications.

It usually refers to digital image processing; one image started to produce modified image version; which an image been discretion both in spatial coordinates and in brightness [4], [10]. The fundamental requirement of digital processing is that images be sampled and quantized; as sampling rate has to be large enough to preserve the useful information in an image by the bandwidth of the image [11].

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In addition, a digital image composed of a finite number of elements that refer to as picture elements, image elements, pels, and pixels; each of elements has a particular location and value [4], [12]. Therefore, digital image processing comprises a wide and various fields of applications.

Mainly process of image is to extract all the information or contents contains in the images. However, the difficulty might happen during the process as variously disturbance such as noisy image, blur image, low resolution and bad contract of image [4], [11]. Thus, image processing emerges with four basics techniques to solve the problem. There are;

- Image enchantment: improve quality of image (increase its contrast).
- Image compression: as few bits to present the image (minimum deterioration in its quality).
- Image restoration : improve image in an objective way (reduce blurring)
- Feature extraction: make implicit certain characteristics of image; used to identify contents of image. (Refer Fig. 2)

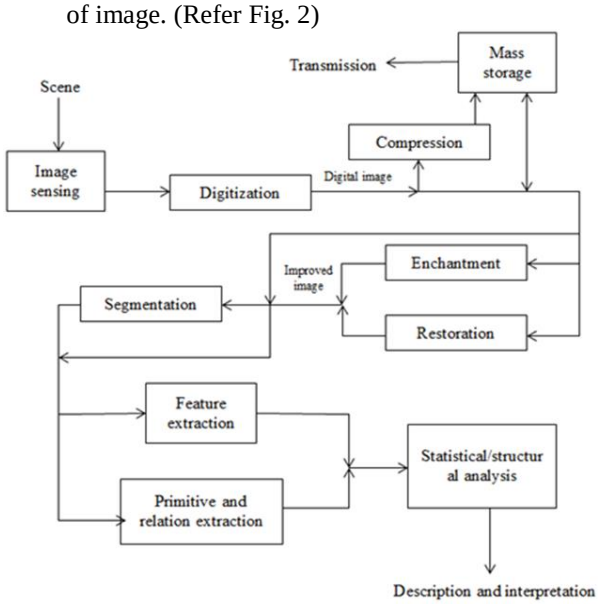

Figure 2. Fundamental of image processing and analysis scheme [11]

The main source of noise in digital images rises during image transmission due to interfering in the channel which is used for the images communication and as a result, images had been corrupted while during programme of images [12]. The main reason of noise is. A noise image can be model as follows:

$$C(x, y) = A(x, y) + B(x, y) \quad (1)$$

where $A(x, y)$ is the original image pixel value and $B(x, y)$ is the noise in the image and $C(x, y)$ is the ensuing noise image [13]. There are some types of noise occur; which are:

A. Uniform Noise

The uniform noise is known as quantization noise cause by the quantizing pixel of image to a number of discrete levels. It has roughly uniform distribution [12].

B. Gaussian Noise or Amplifier Noise

This kind of noise is an impulse noise but its intensity values are drawn from a Gaussian distribution and it is an idealized form of white noise, which is caused by random variations in the signal [12], [14]. It is a major part of the read noise of an image sensor that is of the constant level of noise in the dark areas of the image as shown in Fig. 3.

Figure 3. Gaussian noise [15]

C. Salt and Pepper Noise

The salt-and-pepper noise is random occurrences of both black and white intensity values as shown in Fig. 4 and also called as shot noise, inclination noise or spike noise. In addition, it called "replacement" noise because some percentage of pixel values is just replaced by random numbers. Usually caused by faulty memory locations playing up pixel elements in the camera sensors, or there can be timing errors in the process of digitization. For 8-bit image the typical value for 255 for salt-noise and pepper noise is 0 [4], [14], [15].

Figure 4. Salt and pepper noise [15]

D. Rayleigh Noise

Radar range and velocity images typically contain noise that can be modelled by the Rayleigh distribution.

E. Gamma Noise

The noise can be achieved by the low-pass filtering of laser based images.

Industrial image usually come out with variety kinds of image. To make an accurate and clear detection and recognition on defects in the image, filtering image processing most common used to reduce and remove noise in image [16]-[19]. Nowadays, there are many types of filter techniques can be found with various kinds of modified algorithms.

III. Application of Filtering Image Processing

Basically, filtering caused due to the replace each pixel intensity value with a new value taken over a neighbourhood of fixed size. Its transform a pixel intensity values to reveal certain image characteristics [19].

According to [12] various application of filtering can contribute in image development and restoration such as noise smoothing, edge enhancement and edge detection. Filters are used to remove noise from digital image while keeping the details of image preserved is a basic part of image processing. The choice of filter is determined by the requirements of the task performed by filter and behaviour and type of the data. It can be classified as nonlinear and linear system [8].

Basically, many of image processing (filtering) operations are model as a linear system [12] as (2):

$$(x, y) \longrightarrow \boxed{\text{Linear system}} \longrightarrow h(x, y) \qquad (2)$$

Almost all image processing systems using filtering image data as a standard process. Filtering can be described into two main techniques which are spatial domain filtering and frequency domain. The two techniques has difference approach as spatial domain filtering is a domain (plane) where a digital image is amorphous by spatial coordinates of its pixels; while frequency domain filtering transforms image to the frequency illustration during perform image processing then computes back the inverse transform to the spatial domain [12].

Mean and median filter are normally use in industry. A mean filters are the simplest filter and known as arithmetic mean filter. It is simply smooth local variations in an image that reduce a noise as a result of blurring. In contrast, median filters are quite popular as for certain types of random noise it provide excellent noise reduction capabilities, with considerably less blurring than linear smoothing filters of similar size [11].

The Mean Filter is a linear filter which uses a disguise over each pixel in the signal. Each of the components of the pixels which fall under the mask are averaged together to form a single pixel. This filter is also called as average filter. The Mean Filter is poor in edge preserving. The Mean filter is defined by [20]:

$$Mean\ filter\,(x_1 \ldots\ldots x_N)^{1}_{=N} \sum_{i=1}^{N-} x_i \qquad (3)$$

where $(x_1 \ldots . x_N)$ is the image pixel range.

In contrast, the Median filter is a nonlinear digital filtering technique, often used to remove noise. Such is a typical pre-processing noise reduction step for improvement of the later processing results [20].

There are some differences between mean filter and median filter, which are the median is less sensitive than the mean to extreme values because those extreme values are more successfully removed. An extreme value is not affected to the median filters as it were too strong. If necessary, median filters can be applied repetitively since edge is minimally degraded [12]. Thus, median filters are better than mean filter as a technique to be applied in industry for the inspection process.

Generally, median filters have been converted into several of types for the improvement to gain the best quality of image.

Previously, the author [17] showed an example using filtering industrial image of the copper slab. The purpose is to demonstrate the performance of simple versions of modified filtering process which is vertically weighted filters applied to the copper slab shown in Fig. 5 (top left panel). The task is to filter out the cracks; which emerged during the burnishing of the metal surface and leaving the defects visible on the copper slab. By applying 11×11 vertically weighted median and mean filters, the cracks are highly reduced, but small defects became much less visible.

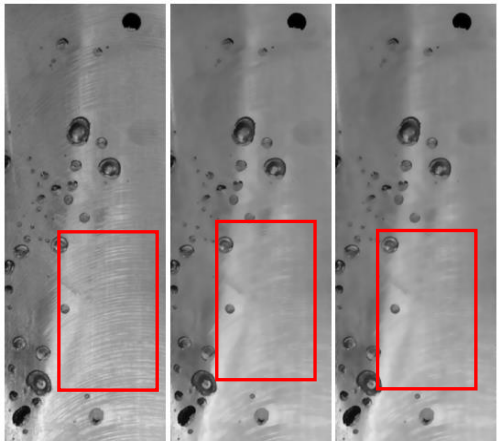

Figure 5. Differences between copper slab with defects and unwanted cracks to be filtered out (left panel), the vertically weighted median (middle panel) and mean (right panel) [17]

Another type of filtering method is wiener filter. According to [20], wiener filter is based on a statistical approach. The main purpose of this is to filter out noise that has corrupted a signal. Typical filters are designed for a desired frequency response and approaches from a different angle.

Different with the wiener filter, hybrid median filter is more easily removes impulse noise while preserve edges. In evaluation with basic version of the median filter, hybrid one has better corner preserving characteristics. This filter plays a main role in image handing out and vision [12].

IV. Image Processing with Scilab

Scilab is an open source scientific software package, and was developed by researchers from INRIA and ENPC, and now by the Scilab Consortium. According to [21], Sci_Resizor, highlighted that Scilab software which is famous open source software used for image resizing. The software is simple and efficient as it combined image. There are two kinds of image processing toolbox in scilab which are SIP (Scilab Image Processing), and SIVP (Scilab Image & Video Processing).

Scilab Image Processing toolbox extends Scilab with various procedures to deal with image files and analyze all of it. There are some of main features; which are Functions to read and write many image formats, filters image, edge detection, geometric transforms, image segmentation, etc. [9].

Scilab is a free software that easy to be use. It useful and almost like MATLAB software. Besides that, it allowed efficiency and used C language to implement in heavier operations.

V. Summary

Image processing performed as aid in industry especially during inspection process. Today's median filter is a most common technique used in varied field application. It contains of various modification algorithms to ensure for the better outcome. Image processing in industrial environment is not unfamiliar because it gives guidance to gain more effectively. For the future work, Scilab software will be used to detect the image of defect and extract all the information.

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