

# Metal Inspection for Surface defect Detection by Image Thresholding

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**Abstract**— Manual quality control is difficult and varies from person to person. An automated vision system can significantly improve the quality control process. The defects finding in this paper includes Surface the defects associated with the metal object as the surface defects plays a major role to ensure the quality of the metal object. In proposed method, surface the defects such as holes, shrinkage, cracks are found by different thresholding techniques. The real-time approach is been used to capture the image of the metal object and experimental results are shown for different thresholding techniques.

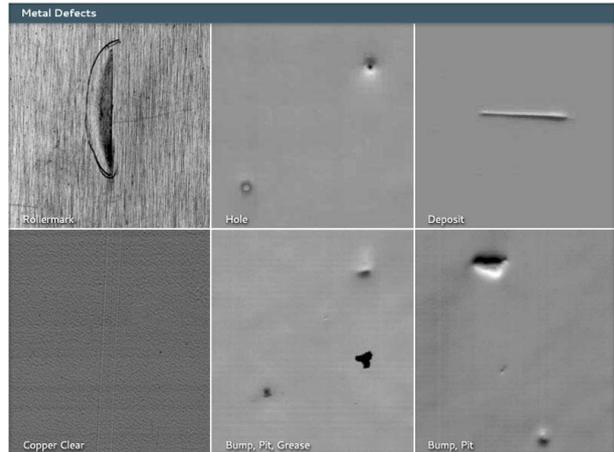
**Index Terms**— adaptive thresholding, binarization, iterative thresholding, Otsu thresholding, Oversegmentation.

## I. INTRODUCTION

Machine vision using image processing algorithms is one of the fastest growing and widely used technologies in the area of manufacturing and quality control due to the increasing quality demands of manufacturers and customers. Machine vision utilizes industrial image processing by the use of cameras mounted on production lines and cells in order to visually inspect products in the real-time without operator intervention.

The issue of Quality Control in metal object is an important aspect of today's highly competitive Industry. The quality of the end product can be improved by inspecting the product at each manufacturing stage in production line. However, manual inspection of end products slows down the entire process as it becomes costly, difficult, time-consuming and also may impact the effectiveness of human labor due to the hazardous atmosphere of the industry. Therefore, the process of inspection is also to be automated and inspection results should be fed back to the upstream manufacturing process for improvement of product quality. However, the Inspection system should be designed to be an efficient composition of human intelligence and experience along with the fastness of a machine. Machine Vision can be used very effectively to find out the faults in the metal object in the real-time industrial manufacturing process.

### A. Types of the defects in metal



**Fig. 1** Different types of surface the defects in metals

#### 1. Surface the defects:

Surface the defects are any abnormality present on the metal surface. The table below gives the types of surface the defects in metal [1].

**Table I.** Types of the defects on metal surface

The defect	Description
Crack	Unwanted discontinuity on the metal surface
Pinhole	Small pinpoint slots
Spot	Discontinuity of color on surface
Edge	Edge discontinuity
Scratch	scratch on surface

#### 2. Shape the defects:

These defects include any shape abnormality if present in the metal object. Shape Changes can occur in production line because of temperature difference, corner or edge breakdown etc.

### B. The Issues in The defect Inspection

At present, there are commercially available products which can detect the presence or absence of surface the defects at reasonable costs. However, this problem still remains an open research issue due to the difficulties faced during The real-time The defect Detection,

Identification and Localization as well. The major obstacles in this area are mainly due to the computational costs, lack of expert knowledge in the defect feature selection or modeling, availability of proper the defect samples etc.

### C. Image Binarization using thresholding technique

It is common to distinguish the binarization algorithm between global and local methods. The global algorithms calculate one threshold for the entire image while the local thresholding algorithms calculate different threshold values depending on the local regions of the image. For the purpose of finding out the defects, binarization is carried out by different thresholding techniques.

Thresholding is an important technique for image segmentation and machine vision applications [3], this thresholding technique has been widely used in the industry for automated visual inspection of the defects. The technique is often referred to as contrast sensing in the machine vision industry. Because of its wide applicability to other areas of image processing and applications, there is a considerable body of work on automatic thresholding to draw from. Global thresholding selects a single threshold value from the histogram of the entire image. Local thresholding uses localized gray-level information to choose multiple threshold values each is optimized for a small region in the image. Global thresholding is simpler and easier to implement but its result relies on good (uniform) illumination. Local thresholding methods can deal with non-uniform illumination but they are complicated and slow. For automated visual inspection applications, where non-uniform illumination is usually not an issue due to controlled lighting conditions, global thresholding is commonly used for its simplicity and speed.

Among the global thresholding techniques, the Sahoo et al. (1988) study concluded that the Otsu method (Otsu, 1979) was one of the better threshold selection methods for general real world images with respect to uniformity and shape measures [3]. This method selects threshold values that maximize the between-class variances of the histogram. The Otsu method is optimal for thresholding large objects from the background; in other words, it is good for thresholding a histogram with bimodal or multimodal distribution. The Otsu method, however, fails if the histogram is unimodal or close to unimodal.

## II. RELATED WORK

Research has been carried out for automatic fault detection and classification for metals by using enhanced Gabor filters [1], this technique is inspired by fault finding in textile materials by Gabor filters. This

automated classification method helps to acquire knowledge about the pattern of the defect within a very short period of time and so that the defected metal may not be mixed with the fresh metal.

The defect region such as crack and shrinkage of the metal surface image is detected by binarization using iterative thresholding technique [2]. The experimental results are carried out by using the real-time metal surface images and satisfactory performance is achieved by the proposed the defect detection technique. The real-time the defected color metal surface images are used in this approach. In order to identify the defects, the input color image is transferred to grayscale. Then the binarization technique is applied using iterative thresholding, in which the defect region is differentiated from the non-defected region. Experimental results prove that the presented the defect detection approach using iterative thresholding technique provides promising performance for the real-time color metal surface images.

The valley-emphasis method which is a revised version of the Otsu method, to automatically select the optimal threshold value for the defect detection applications is proposed [3]. The method selects a threshold value that has small a probability of occurrence and also maximizes the between group variance in the gray-level histogram. The small probability of occurrence requirement ensures that the resulting threshold value will always be a value that resides in the valley of two peaks, or at the bottom rim of a single peak. Therefore, the valley-emphasis method is able to select optimal threshold values for both bimodal and unimodal distributions. This is essential for the defect detection applications because the defects range from no the defects through small and large the defects. They have demonstrated the effectiveness of the proposed method on various the defect detection applications such as contamination inspection, ceramic body the defect detection, and metal sheet scratch inspection. The experiment results suggest that valley emphasis method is effective for selecting threshold values for the defect detection applications. The proposed method is simple and fast.

T.Aarthi and M.Karthi [4] proposed a new method for explicit analysis of surface the defects. In this proposal, the images are acquired using a Panasonic BBHCM381 camera. These images are subjected to 2-dimensional discrete wavelet transform which uses subband coding algorithm for feature extraction. The analysis of surface features is rendered by obtaining numerical data from the image. This data aids in performing statistical analysis that involves the calculation of mean, variance, standard deviation, skewness and kurtosis from the acquired image. These parameters are calculated for different wavelets like HAAR, Daubechies, and a comparative

study is made. LabVIEW is the system design platform used for developing this application.

Aswini.E and Divya.S [5] proposed the method which deals with the structural the defects (i.e. crack) on metal disc surfaces in relays. The acquired metal disc images were enhanced by the preprocessing techniques. To extract the cracks in metal disc surfaces two methods were proposed. The first approach used mathematical morphology and watershed segmentation. The second method makes use of mathematical morphology and bottom-hat filtering. The result shows that the later approach is superior for crack detection.

Jijina K. P. [6] proposes an efficient approach for the detection and classification of the defects by using image processing algorithms. From the pre-processed image, the defect areas are located and segmented using morphological operations. GLCM attributes, geometric attributes and the moments are extracted to characterize the defected region. Back propagation neural network allows an accurate classification independent from the level of load. The system is capable of both detecting and classifying surface the defects.

### III. PROPOSED METHOD

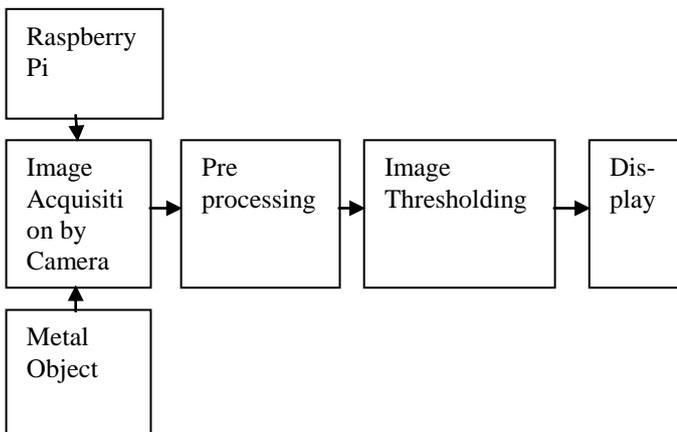


Fig. 2 Block Diagram

Images of the metal object will be taken in the real-time by Pi camera or it can be taken with any camera compatible with raspberry pi as results in the real-time are required.

Raspberry Pi is a single board, credit card size computer which is used in place of CPU to minimize the hardware cost and size. The camera can be easily interfaced with raspberry pi as it has USB ports. Here, Pi Camera of resolution 5 MP is used to capture the image.

Preprocessing is done on the image of the metal object to remove noise and other image acquisition errors. Preprocessing will also consist of RGB to gray

conversion as grayscale image gives better accuracy to the defect detection.

Feature extraction will include actual the defect detection by thresholding gray level image.

Following thresholding techniques are applied on gray level image of metal object-

1. Global thresholding
2. Adaptive Mean Thresholding
3. Adaptive Gaussian Thresholding
4. Otsu Thresholding

Process for finding out the defects is expected to be atomized, to avoid false acceptance or rejection of metal objects in the manufacturing process.

### IV. EXPERIMENTAL RESULTS

In order to evaluate the performance of the surface the defects detection system, experiments are carried out using the real-time metal surface images and applying different image thresholding techniques.

Image of the metal object is taken in the real-time by the Pi Camera. The proposed the defect detection system is processed by converting the color image into grayscale image. Then the grayscale image is then processed by different thresholding techniques to find out the surface faults. An experimental result here shows that global thresholding and otsu thresholding gives more visual discrimination for faults than other thresholding methods. If the background is relatively uniform then global thresholding gives satisfactory performance. However if there is a large variation in background intensity then there is a need to use adaptive thresholding.

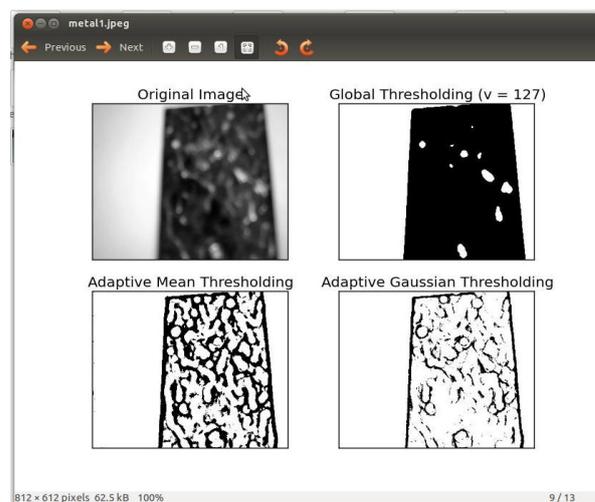
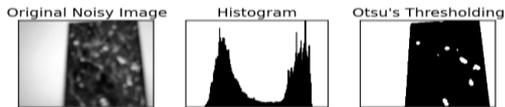


Fig. 3 a) Original Image b) Global thresholding c) Adaptive Mean Thresholding d) Adaptive Gaussian Thresholding



**Fig. 4** a) Original Image b) Histogram plot c) Otsu Thresholding

The Otsu method gives satisfactory result when the images to be thresholded have clear peaks and valleys. That is it works well for images whose histograms show clear bimodal or multimodal distributions as shown in fig.4.

## V. CONCLUSION

In this paper, efficient surface the defect detection is presented based on different thresholding techniques. The real-time defected metal surface image is used in this approach. In order to identify the defects, the input image is transferred to grayscale. Then the binarization is done using different thresholding, in which the defect region is differentiated from the non-the defect region. Experimental results prove that the presented the defect detection approach using thresholding provides promising performance for the real-time metal surface images. Automotive defect detection will help the industry to maintain the quality of product with less false detection and increased speed. This will completely eliminate the need for the human expert from quality inspection. Use of Raspberry Pi over CPU will minimize the system overall cost.



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