DETECTION AND CLASSIFICATION OF METAL DEFECTS USING DIGITAL IMAGE PROCESSING

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ABSTRACT

Digital Image Processing is one of the most basic and prominent tool in image processing and computer vision. We can detect metal defects using Digital Image Processing in a very easy manner. Surface quality of metals should be regularly tested before making them available in industries. Traditional testing methods are not such effective due to its low productivity and lower reliability. This paper presents a simple and efficient method for metal defects detection and classification using Digital Image Processing.

Keywords: Metal Defects, Digital Image Processing, Casting, Welding, Weiner filter, BP Neural Network.

I. INTRODUCTION

Metal is an important raw material for industries. Surface quality should be tested before making the metals available for processing in industries. Metal with surface defects are rejected at manufacturing time to avoid further errors. Early detection reduces damage and manufacturing cost of products. We have different metal defects and the larger defects are more critical then the small ones .Defects greatly reduces the speed of production which in turn affects the market value of products.

Manual inspections of end products are not an effective solution as it greatly slow down the production and add to the cost of products. Reasons of surface defect include degraded raw material or rolling process manufacturing. Larger surface defects include crack, cavities, porosity, misruns, incomplete fusion, fins etc. Smaller defects include pits, bumps, holes, scratches that remain unnoticed until operation is incomplete.

Fig.1 Surface Defects

II. INSPECTION

It is an important part of manufacturing activities. Castings and welded structured objects may have different types of defects that include cracks, porosity, misruns that have differing shapes, sizes and also differing locations. The metal may have different feature like holes, slots and pockets, ribs and curved surfaces that leads to high complexity. Difficulty is particularly in high production foundary and dearth of qualifies inspectors has lead to automation of this task.

There is a system that creates a model for inspection after being trained on a number of 'good' and 'bad' parts. This has been demonstrated on a circular shape that is useful to detect the misplaced components in an assembly. All these methods have been prescribed for planar objects or simple shapes. While the automatic system should be such to handle any casting shape, should be minimum intervened, fast and should not depend on ideal image for comparisons.

III. METAL DEFECTS

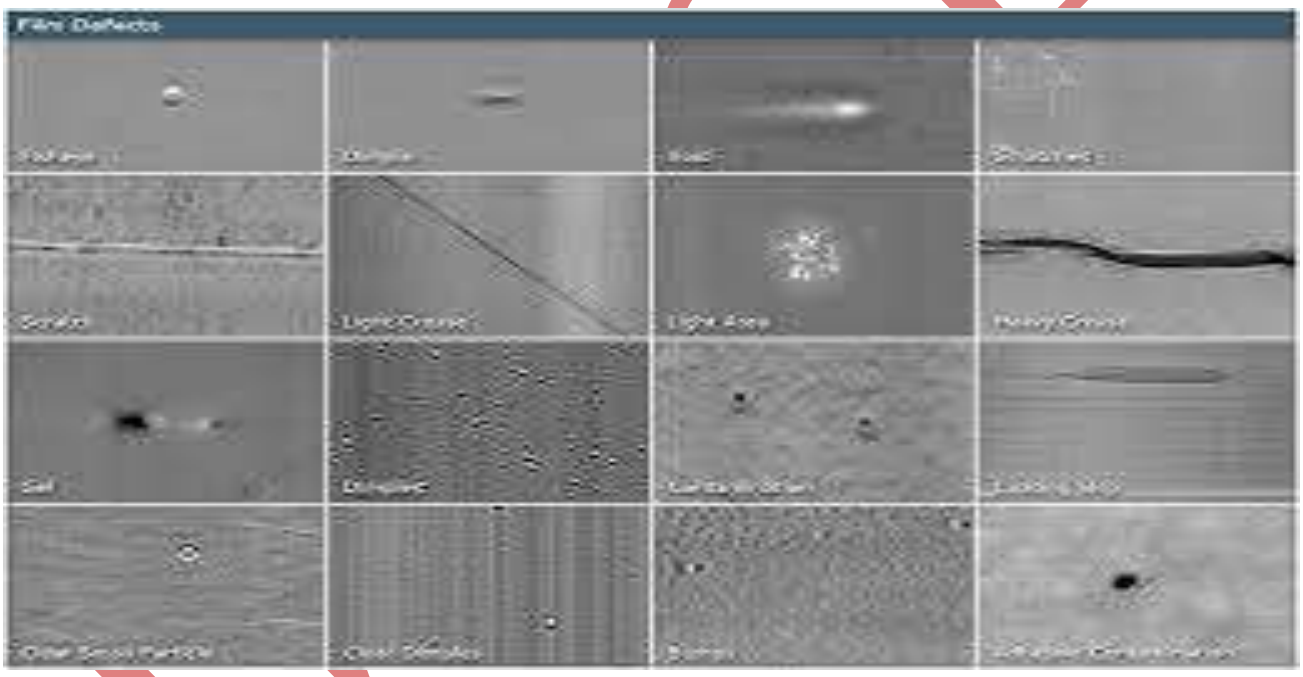

Fig.2 Different Metal Defects

There are different kinds of surface defects in metal and the most common and most occurring defects are deposit and metal cracks. Theses defects are optical surface flaws that can be detected with naked eyes. A metal surface is said to be detected if it deviates enough from the average metal surface.

IV. METHODOLOGY

The methods included are defect detection, defect segmentation, feature extraction, defect classification.

4.1 Defect Detection

The first task is to capture image from the plant. After capturing of image the first step is ROI i.e. (Region of Interesting) detection to find out the defects on the metal surface, ROI exists if the difference between the

reference and target image is over the given threshold. In case of no ROI there will be no need of dealing with or image waits for further process. Noise is present in image which is to be reduced using weiner filter.

The noise mixed with motion blurred because of the environment factor and transmission channel. Smoothing is done by weiner filter and then with the help of appropriate threshold binary image is achieved.

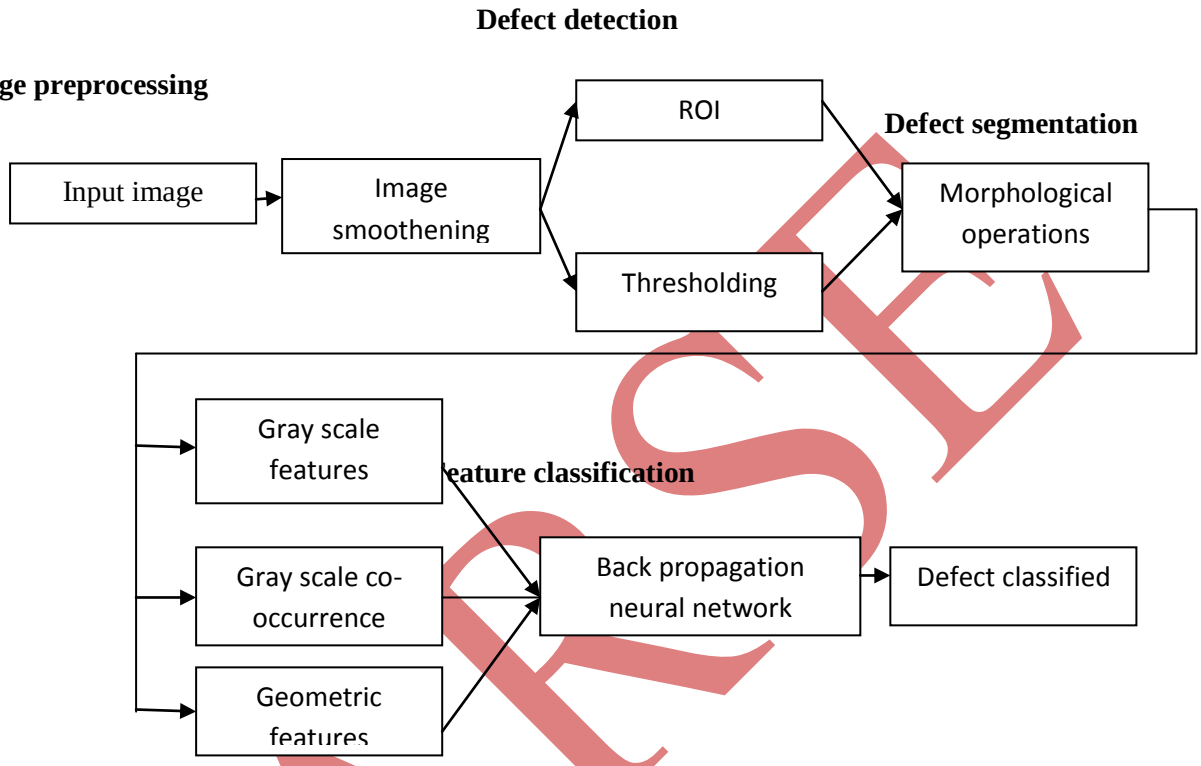

Fig.3 Prototype of Proposed System

4.2 Defect Segmentation

It is necessary to adopt morphological analysis for binary images to detect small area covering single defect. Each detection algorithm is not applied as it may give false edge. Here maximal similarity based region merging is used as defected area have pixel values different from that of a perfect metal. After detecting defects the areas undergo thresholding.

4.3 Feature Extraction

When the region of defect is found the feature from defect images is extracted. It includes geometric one, gray ones and texture features.

The common characteristics are gray characteristics, texture characteristics, geometric characteristics, morphological characteristics, etc. to find the defect types.

The characteristics of defects images are as follows-

1. Gray characteristics- It can be obtained by gray-scale histogram. Histogram is in probability scale and statistics for various pixel distribution in gray-scale images.
2. Gray co-occurrence matrix features- It is represented by P,

P (i,j) (i,j) = 0,1,2,3....L-1

Where i,j is corresponding pixel gray scale.

L is gray scale series.

The texture characteristics from gray co-occurrence matrix is-

Contrast- The clarity of images depends on the image contrast. If image contrast is greater than clarity of image will be more.

Correlation- It measures the degree to which the lines or row elements are similar of co-occurrence matrix.

Entropy- Entropy will be zero if there is no texture in image. If texture is more than more will be entropy otherwise small entropy.

Homogeneity- It measures pixel homogeneity.

3. Geometric features- It includes region area, perimeter of defects, border and the region's centre of gravity and so on.

Area = determines defect area

Perimeter = no. of pixels through the border

B is defect image border

Centre of gravity = overall image details and its coordinates are calculated by pixels in the region.

4.4 Defect Classification

Defect should be classified correctly according to the cause of defects. The most commonly used method to classify the defect is Neural method. The measured features of defected images which vary in a long extent undergo training through Neural network, then the defected images are classified into exact class. BP Neural is used to classify defects as it has good adaptability, robustness and fault tolerance. Neural network is determined by 10 defect features input node and 3 typical sort of defects output node.

Fig.4 Hole Defect

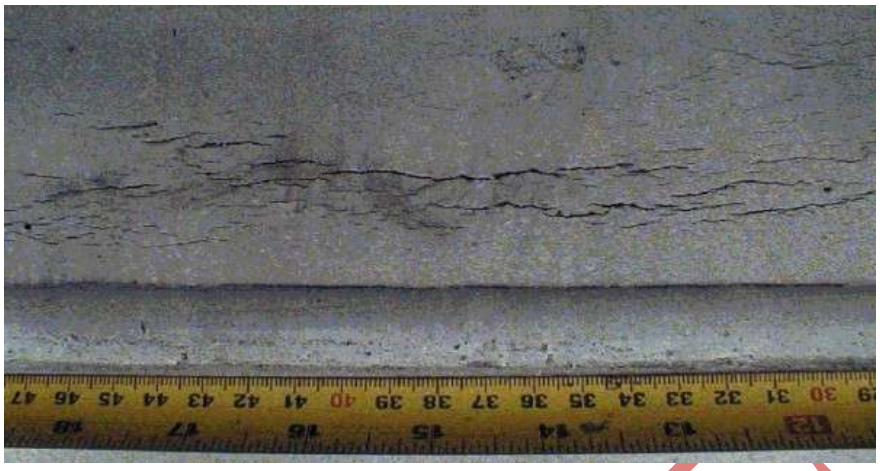

Fig.5 Crack Defect

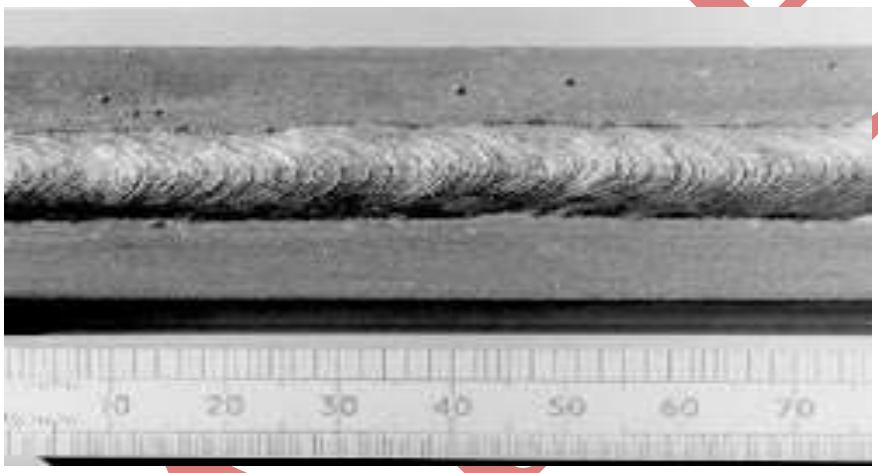

Fig.6 Deposit Defect

V. CONCLUSION

From this paper, one can conclude that metal defects can be detected using image processing algorithm. It can detect defects from images successfully. The present work is being extended to detect other external defects. This method detects the surface defects of metal images and reaches the exact position and it is implemented in Matlab.

In this paper, the feasibility of automatic detection of surface defects in metal using machine vision and image processing techniques. It does not require any image enhancement, conventional noise reduction, ideal images for comparison, training or instruction.

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