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Prediction of Different Types of Defects in Casting Surface Using Image Processing Techniques

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ABSTRACT

Digital image processing techniques and its advancements helps in performing the process of defect detection in hard reflective metal surfaces. Metal surface defect identification is required pattern recognition issues. The current paper uses Multi Class Support Vector Machine (Multi Class SVM) technique one of the popular classifiers in image classification. The acquired image is preprocessed by removing noise present in the image. K-means clustering is applied in segmenting the images based on the specified features like size, texture, contrast, etc. The proposed method shows enhanced results in classifying the defective region in the metal surface.

Keywords:— *Metal Surface Defect Detection, Multi class Support Vector Machines, K-Means Clustering, Feature extraction.*

1.INTRODUCTION

Generally, metals like aluminum, gold, copper and silver, Iron, etc, naturally have strong reflection capacity. Nowadays these metals are been widely used in different industries as raw material for producing various finished products. These industries include power electronics, automobile industries, shipping, domestic electronics, communications and construction industries, etc. It is inevitable that the surface quality of these materials affect the quality and durability of the finished products. On the other hand, defect analysis of these reflective materials is strongly recommended in large scale industries. Though the traditional methods like visual detection and flashlight detection are applied in defect analysis they fail to give high accuracy rates due its low random inspection, failure accept real time capability, poor inspection atmosphere the industrial requirements are not met. As a solution, the development of newly enhanced vision based method to detect the defect in these materials has been encouraged. The enhanced quality dimension support to advance the performance of the system as described below:

1. Process control is improved immensely.
2. Efficiency of the algorithm to detect defected region is enhanced.
3. it reflects in smooth relationships with customer.

Most of the presently applied inspection systems perform defect detection. However, defect classification still remains a research subject.

1.1.Challenges and Issues in Defect Detection

Currently there are many defect identification systems which can perform surface defect detection in strong reflective metals. But these systems are commercially available which are high in cost[9]. Though problem defect identification is addressed by various systems still the technique of defect classification i.e., defect region identification, prediction of affected feature, and the optimal classification are to be addressed.

Inspection within metallic surfaces is conditioned by:

Mostly, the coefficients of strong reflective metals are high which makes designing of lighting system for defect enrichment.

As the metal surface are moving under the defect inspection systems it results in higher volume of data i.e. approximately metal is 1-2 m wide and they move in average speed of 2-3m/s. Accordingly the huge volume of data for cen-percent inspection is tedious naturally.

There is variety of defects in metal surface. Though it is classified in single class the defect can be entirely different in its size, texture, depth which would result in faulty finished product.

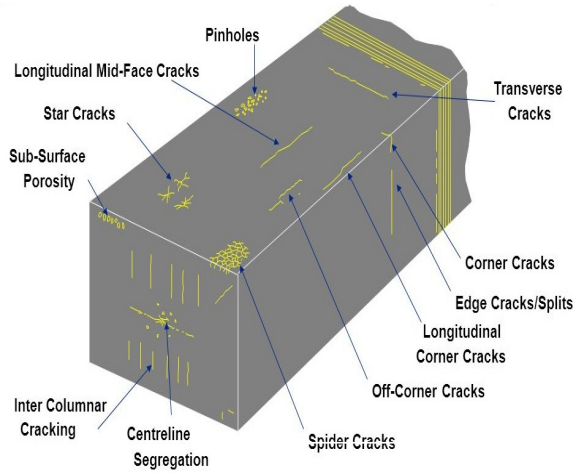

Figure: 1 Common defect in surface of metal

Figure 1 shows common defects that mostly found in surface of metal. Here, even the efficient classification procedures experience the difficulty in identifying the defects in strongly reflective metals. Because most defect metals are very tiny in nature and the holes, stains, scratches, pilling, indentation, burrs and other ill-defined defects are deep rooted in the metal. As these defects are refractive in light and makes the automatic defective system to be faulty.

In recent scenario, advancements in image processing, computer vision techniques, AI and similar fields have considerably enhanced the ability of visual inspection techniques[4]. Till date there are several types of inspection systems are proposed which almost included image processing and pattern recognition technique to an extent.

II. PROPOSED METHOD

Noise is a part of image acquisition process. The noise would extremely affect the captured image resulting in blur vision, difficulty in edge detection etc. Hence, it is recommended to de-noise or weaken the noise present in the image. This can be removed by applying appropriate image filtering techniques.

In the present work authors have implemented wiener filter to de noise the image. Application of wiener filters result in analyzing the known signal to detect the unknown signals by relating the known signals as input. Weiner filter uses statistical approach to filter the trained data set.

Phase I also includes the process of image resize, cropping, contrast enhancement, color conversion to obtain the desired result. Further, the captured image is resized to standard resolution hence it can

reduce the amount of computation capacity of the model which on the other hand increases the computation speed. The image is converted into grey scale image to identify the defect region[9]. Figure:2 shows the process of input of original image for preprocessing by applying wiener filter.

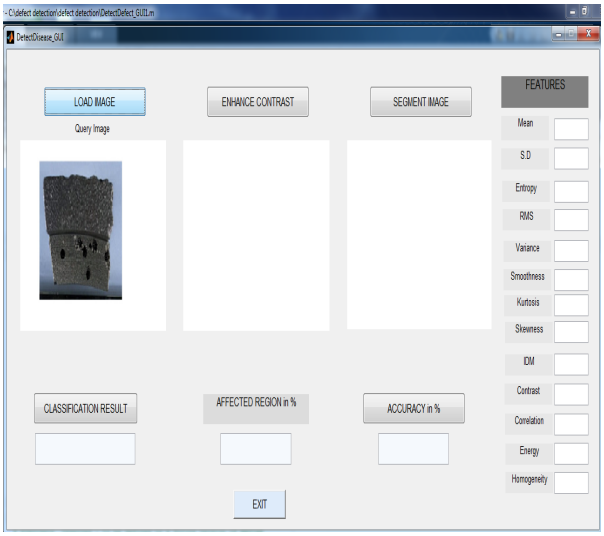

Figure:2 Original Image

Moreover, in Phase II image segmentation by applying k-means clustering algorithm to identify the defected region. The segmented region is further passed as input to the Phase III where the affected features are extracted from the defected region of image. Finally, in Phase IV the defected region is classified from the input image.

Given flow describes the working of defect identification model in detail:

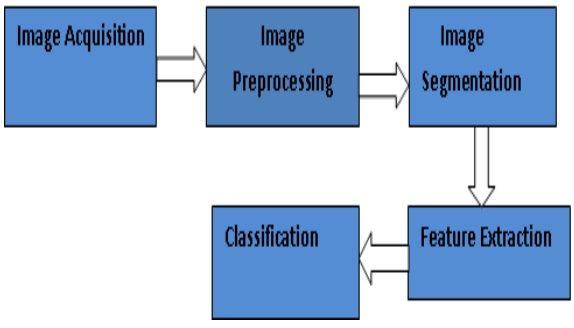

Figure: 3: Flow of Defect Identification in Metal surface

III. Result and Discussion:

3.1. Contrast Enhancement

From Phase I the de-noised image is further included for contrast enhancement by converting the image into grey scale image. The grey scale images are very supportive in applying the defect identification techniques as the intensity differs consistently in the image.

Tonal enhancements results in progress of highlight, midtone, shadow are mentioned as bright, gray, dark regions in the image. Figure 4 shows the result of contrast enhancement in the image after preprocessing. This results in identifying the signals which contradict with the signals present in the image.

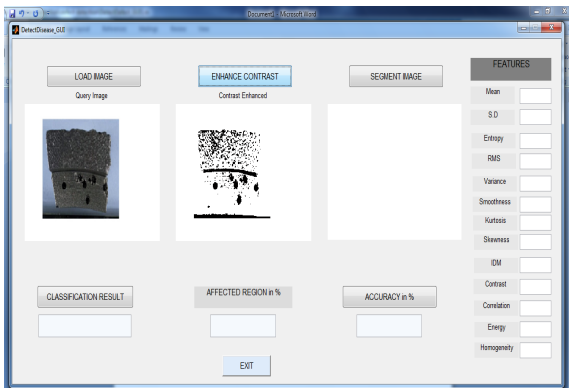

Figure 4 : Contrast enhancement.

3.2. Image Segmentation

Image segmentation is attempted to extract a part of image or a segment to make it easier to analyze. It also ensures the task of restoring the more meaningful and related data. The process of segmentation has to be carried out to a point where the required part of the image is isolated from the core image.

The current work concentrates in segmentation is to identify the region which are to be classified to be defected area. There are various techniques for

image segmentation such as clustering methods, compression-based methods, histogram-based methods, region growing methods etc.

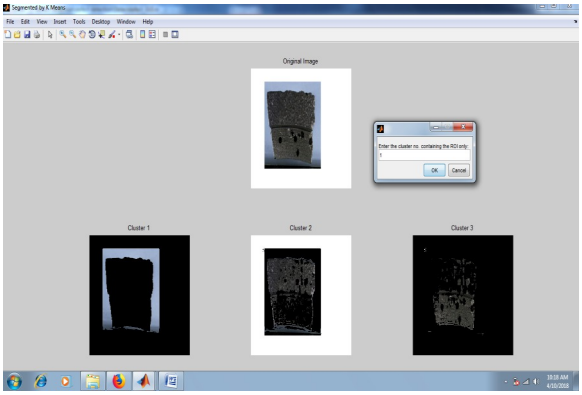

Figure:5: Segmentation of Defected Region

K-means clustering is the technique used in the present work to proceed with segmentation of images. K-means clustering is a technique of analyzing the clusters which aims in partition of n observations into k mutually exclusive clusters which belongs to the clusters nearest mean. Figure:5 shows the segmented image with spots of defective region being extracted.

3.3. Feature extraction

Feature extraction technique is used to features of the denoised image. Feature extraction is carried out by withholding the maximum possible information from the given large date set.

Though feature extraction is required process in image processing its efficiency and effectiveness of feature selection and extraction are severe challenge nowadays. In this paper features like color, texture and shape are extracted for segmentation process.

3.4. Classification of Defect

In the final phase segmented image is passed to classify the defective region in the processed image. Support Vector Machine tends to classify the classes into binary i.e (L=2) where the problems in reality may require multiple categories. Here, multi class Support Vector Machine is technique is used to classify the defective region various categories. Multi class SVM is widely applied in various fields due its efficiency of classifying the problems into (L >2) category.

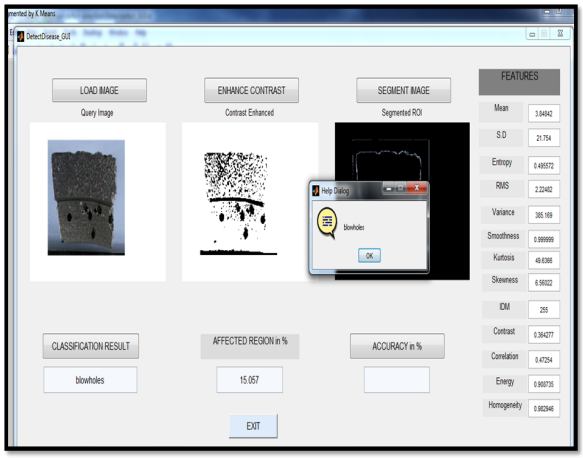

Figure:6 : Classification using Multi Class Support Vector Machine.

Figure:6 shows the effective result of application of multi class SVM. The algorithm provides the classified result of the defect region in the metal. These classes are labeled in different categories based on the supervised learning of the algorithm. Therefore, the proposed model yields desired results with remarkable outcomes.

IV. CONCLUSION

Multi class support vector machine algorithm is implemented to classify the multiple categories of defects in the reflective metal surface. The image is passed into different phases after de-noising the original image. The image is resized into fixed resolution and the data is

converted into gray scale to enhance the contrast in the image. Descended to this, Segmentation of defective region is identified by applying k-means cluster algorithm. Therefore, the desired result is obtained with greater efficiency.

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