Detecting Imperfections in Steel Blades Using Digital Image Processing

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Abstract—Blade imperfections are a significant explanation behind low quality and of shame for makers. Review forms done on these commercial ventures are for the most part manual and tedious. To diminish mistake on recognizing sharpened steel deformities requires more automated and precise review process. Considering this failing to offer, this examination actualizes a Blade Defect Recognizer which utilizes machine vision procedure with the blend of the local thresh holding to recognize conceivable deformities. The recognizer recognizes the blade deserts inside prudent cost and delivers less blunder inclined investigation framework progressively. With a specific end goal to create information set, essentially the recognizer catches computerized blade pictures by picture obtaining gadget and proselytes the RGB pictures into binary images by restoration methodology and local threshold strategies. Later, the yields of the prepared picture are the region of the flawed divide and figure the conceivable imperfect and non – defective blade as an output.

Keywords: Steel Blade, Digital Image Processing, Thresholding, Fault Detection, Teeth

I. INTRODUCTION

A steel blade [1] or piled steel is a knife, sword, or other tool blade made out of layers of differing types of steel, rather than a single homogeneous alloy. The earliest steel blades were laminated out of necessity, due to the early bloomery method of smelting iron, which made production of steel expensive and inconsistent. Laminated steel offered both a way to average out the properties of the steel, as well as a way to restrict high carbon steel to the areas that needed it most. Laminated steel blades are still produced today for specialized applications, where different requirements at different points in the blade are met by use of different alloys, forged together into a single blade.

Piled steel developed out of the necessarily complex process of making blades that were both hard and tough from the erratic and the unsuitable output from early iron smelting in bloomeries. The bloomery does not generate temperatures high enough to melt iron and steel, but instead reduces the iron oxide ore into particles of pure iron, which then weld into a mass of sponge iron, consisting of lumps of impurities in a matrix of relatively pure iron, with a carbon content of around 0.06%. The bloom must then be heated and hammered to work out the impurities, resulting in the relatively soft wrought iron.

Iron is too soft to make a good cutting edge; a good edge requires the addition of carbon to make steel. By heating thin iron rods in a carbon-rich forge, carbon could be added to the surface, making a thin layer of steel on the surface through a process called carburization. From the beginning of the Iron Age, around 1200 BC, piled steel was the only way to get good steel. Obtaining the right level of carbon was an art, and was very important for the finished product. Too much carbon, or too many of the wrong trace elements, and the resulting steel becomes too hard and brittle, which can result in a catastrophic failure of a sword; too little carbon and the sword will not hold an edge. The ideal sword is one with a hard, sharp edge, and tough enough to bend, but not to shatter.

As the mechanical advancement is going on the items are presently broadly made utilizing steel material which needs to be ultra-lightweight and particular in nature steel segments like blade, according to industry measurements we have observed that blades are comprised of steel material which is inclined to different sorts of deformities when assembling utilizing of image processing. Consequently, we recommend a completely vigorous framework taking advantage of image processing techniques (image segmentation, non-smooth corner detection and so on) to assure total quality management in assembling cost effective units.

This paper is organized into Section I includes Introduction, Section II Related work done, Section III Methodology, Section IV Results and Section V Conclusion and Future Scope. Efficient way out

II. RELATED WORK DONE

J.D. Verhoeven [2] had discussed that the art of producing the famous 16-18th century Damascus steel blades found in many museums was lost long ago. Recently, however, research has established strong evidence supporting the theory that the distinct surface patterns on these blades result from a carbide-banding phenomenon produced by the microsegregation of minor amounts of carbide-forming elements present in the wootz ingots from which the blades were forged. Further, it is likely that wootz Damascus blades with damascene patterns may have been produced only from wootz ingots supplied from those regions of India having appropriate impurity-containing ore deposits.
Deng Seir [3] Due to the high demands for productivity and quality of the bearing and the shortage of traditional detection methods, this paper proposes an automatic detection system based on machine vision technique. The detection system uses digital image processing technology to process the images collected by the CCD camera and finish identification for the surfaces of bearing quickly and accurately. Firstly, least squares fitting and annulus scan are used to locate the bearing and the regions which will be detected. Secondly, contrast enhancement and low-pass filtering are used to improve the quality of images. Next, object inspection is applied to determine whether defects exist. Finally, the shape feature is used to finish recognition of defects.

Kunakornvong [4] in 2012 explained that one important part of a read/write head in hard disk drive is Air Bearing Surface (ABS), therefore its verifying is necessary. The main problem of verifying ABS with machine vision in the manufacturing process is the variance of luminance intensity that affects image acquisition. Therefore encoding image input by using texture unit number can decrease the variance of luminance because its characteristic is processed in local terms which have no effect of luminance variance. Two PCA coefficients are sufficient for detecting the defected of the samples. This research proposes a method for reduce variance of luminance intensity by texture unit, then extracting the features of ABS, with Principle Component Analysis, and a selected threshold for clustering defected and non defected ABS by mean of threshold set which has a minimum summation of two types error as false rejection and false acceptance from training data. The experimental results show that without Texture unit, defected and non-defected ABS cannot be clustered. This proposed method is better used because it can be reduced variance of luminance intensity.

Ali et al. [5] in 2011 developed an automatic visual inspection for the lateral surface of cylindrical objects using cameras and image processing technique. In this paper, the main concern was on the hardware tools that are needed to test the defects of the cylindrical objects and to make comparison between the lines scan and matrix camera. The proposed inspection was carried out with the line scans camera system, matrix camera with conical mirror and multi flat mirrors systems. In this paper the comparison between these systems in terms of resolution and accuracy is always significant, depending on the results of the experiments, for the same tested objects. The image of line scan camera image has the best accuracy and best resolution; whereas the developed view of conical mirror has good resolution and accuracy, instead of five flat mirrors, that has good resolution but bad accuracy.

III. METHODOLOGY FOR FINDING DEFECTIVE AND NON-DEFECTIVE STEEL BLADE

![Flow Chart for finding defective and non-defective blade](image_url)

The steps of the proposed methodology are mentioned as follows:-
Step 1. The input image is read by using imread function.
Step 2. The algorithm can be tested for gray scale by appropriately using functions.
Step 3. The steel blade image quality is enhanced by using the enhancement techniques.
Step 4. The noise quality of the image is enhanced by applying filters.
Step 5. Segment the biggest item, i.e. steel blade image.
Step 6. Calculate the labels, i.e. number of teeth of a steel blade.
Step7. If the number of teeth matches with the subscribe number, then the steel blade is non-defective, otherwise the steel blade is defected.

IV. RESULTS

To see the subjectively and additionally quantitatively execution of the proposed calculation, a few analyses are led on several coloured and grayscale images. The adequacy of the methodology has been defended utilizing diverse pictures. The results are figured subjectively (outwardly) and also quantitatively utilizing quality measures.

The following figures are the images of the proposed work which shows the different images which consists of original images and output blade images.

Fig. 1 The RGB image of the steel blade as an input.

Fig. 2 The blade image is converted into a grayscale image by using complement code for increasing the visibility.

Fig. 4 The grayscale image is converted to a binary image for increasing the visibility with respect to the surface.
Fig. 5 Identify the outer as well as the inner circumference of teeth based on a dummy scan algorithm.

It is a Defective Blade and its no. of Teeth are : 31

Fig. 6 Count Number of teeth

The above image count the number of teeth of the blade image for checking whether the number of teeth are same as that of the subscribe number. If the number of teeth matches with the subscribe number, then the blade is a non-defective otherwise it is defected.

V. CONCLUSIONS & FUTURE SCOPE

Firstly, in this paper, we have possessed the capacity to discover deficient blades which have a particular number of teeth. If the quantity of teeth is distorted or pretty much than the subscribe number, then the blade is inadequate in nature and thus the blade is inoperable.

In the wake of directing the above strategy for deformity identification we propose that in future we must exploit some machine learning calculations for making imperfections locating more dependable and powerful. There are a number of future conceivable outcomes for enhancing the execution of these identification calculations like use of machine calculations which help to recognize the imperfect parts as these happen over a time of time. They build their precision focused around the overhauled parameter set and scenario machine algorithm like Support Vector Machine, K-NN and neural network can be used.

REFERENCES