INDIAN INSTITUTE OF TECHNOLOGY, JODHPUR
B.TECH PROJECT REPORT

A PREPRINT

Title of the B.Tech Project:
Classification of Surface Defects From Captured Images during Manufacturing Processes.

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ABSTRACT

The images which we obtain during manufacturing processes have a lot of degradation. But the machining process in general, leaves the impression on the surface which has unique signature for a unique parameter setting. Ultimately those parameters have to be measured. Since the images aren't efficient enough and the impression are not clear, we hereby try to correct the images so that the bigger problem of parameter estimation can be solved. Hence, in this project we have taken close look at the images, estimating different parameters like gradients of the curve, morphological operations on the image etc. to be able to align the pixels of the images accordingly. We were ultimately able to join two curves by selecting them, and also got a result after letting it happen automatically.

***K*eywords** gradients · morphological operations · join curves · parameter estimation · manufacturing

1 Introduction

In this era of technology, yet it is not possible to get a fine image of the surface of any metal during manufacturing processes. The machining processes leave behind important impressions on the surface which are of significance, like solvent extraction, physical properties like roughness, some functional performances etc. But the images that are obtained are not efficient and hence the impressions are not clear enough. Bigger problems of parameter estimations depend on the image, which could be solved if the images get improved.
Our project aims on improving the image, so as to be useful enough for parameter estimation. We have analysed the image on the basis of various functions before coming to the conclusion.
Our first outcome was the joining of two curves by selecting them. Later, we finally were able to get an output by comparing the gradient values of the pixels of the binary image of the main image. Though the image is dilated, the result is an expected one.

2 Problem Statement

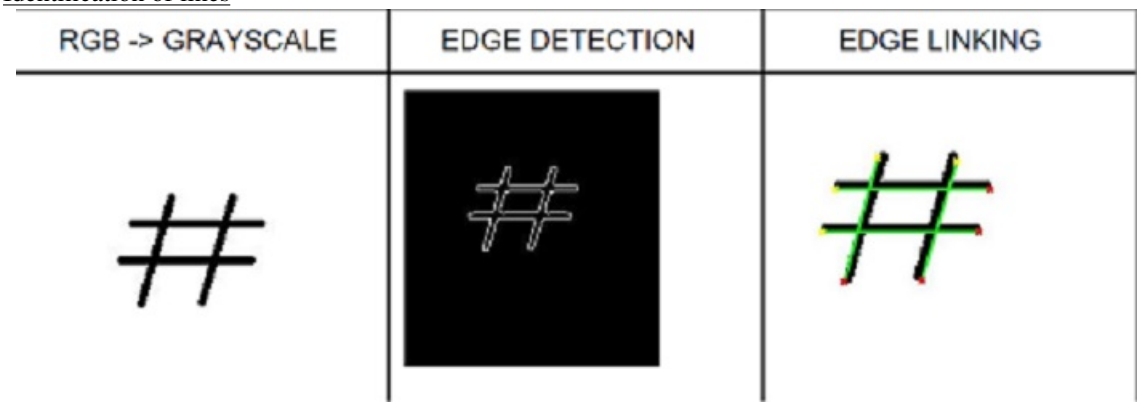
During manufacturing processes, the image obtained is of degraded quality. The processes leave behind impressions on the surface of the metals, which are of great significance for extraction of features of the metal. They are also useful for measuring useful metal parameters. In such cases, the images have to be corrected for the bigger problem of parameter estimation to be solved. So, this projects aims to classify such surface problems and to get a solution for their future use.

3 Approaches

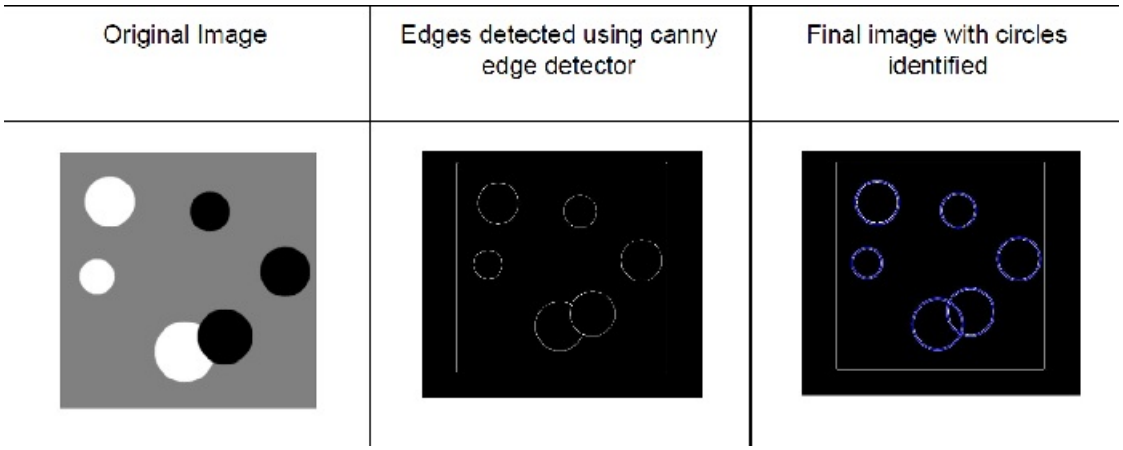
3.1 Approach 1: Hough Transform

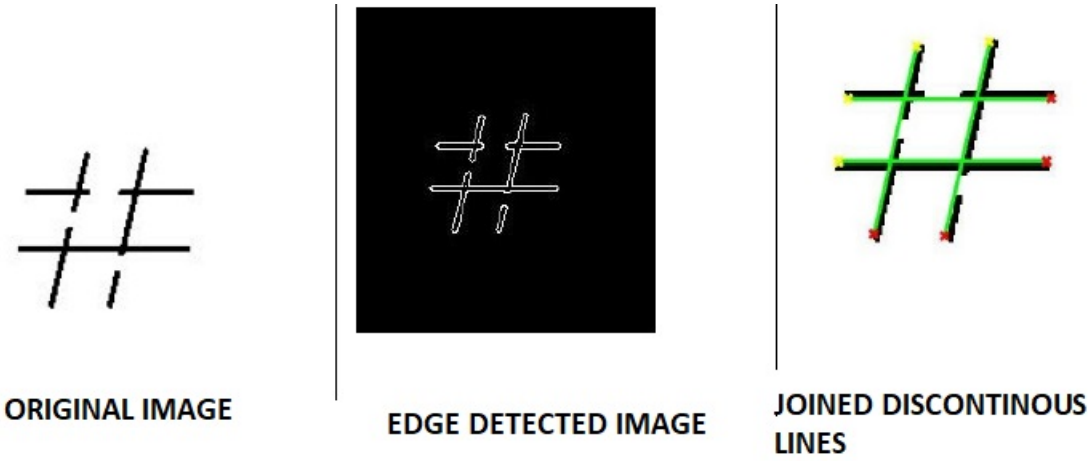
Image obtained from manufacturing processes could be combination of unknown shapes like lines, circles, unidentified curves etc. We first proceeded with hough transform. Hough transform is used to defined shaped from imperfect images of objects using voting technique. In our project, we also joined discontinuous lines, approximating the range between two points on two different lines.
It is well defined that there is a single line passing through two points. In hough transform for straight lines, each edge point is transformed to a line in the Hough space, hence all possible lines through that point are analysed and the areas where most Hough space lines intersect is interpreted as true lines in the edge map. However for circles, we first set the range for the possible values of the radius of circles in the image, then voting happens for all the edge points on the basis of number of circles passing through them.
The steps involved in identification are:
1. Conversion of image from RGB to Grayscale.
2. Edge Detection using Canny filter.
3. Identification using Hough Transform.

Identification of lines



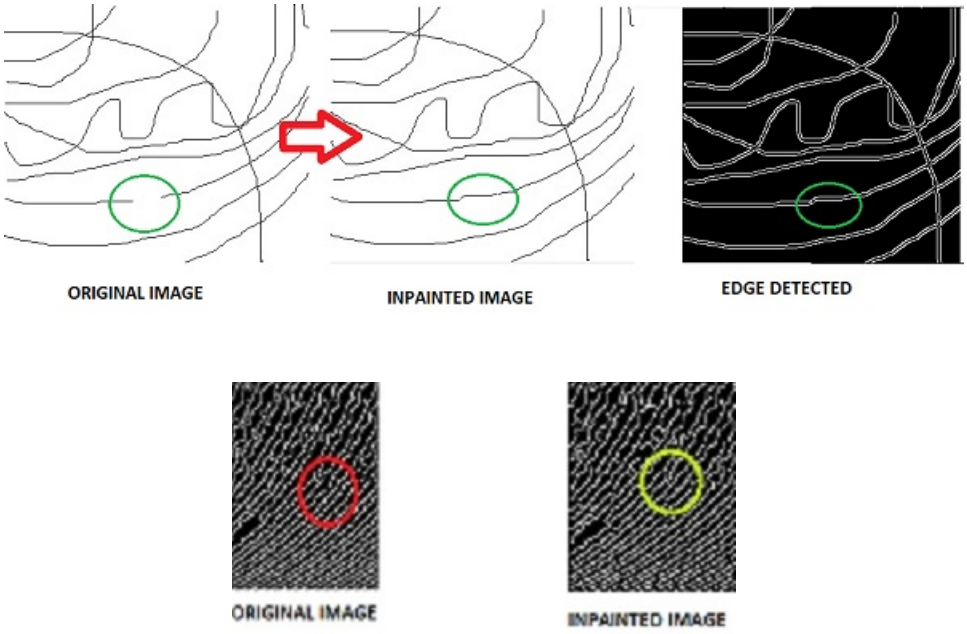
Identification of Circles





3.2 Approach 2: Image Inpainting

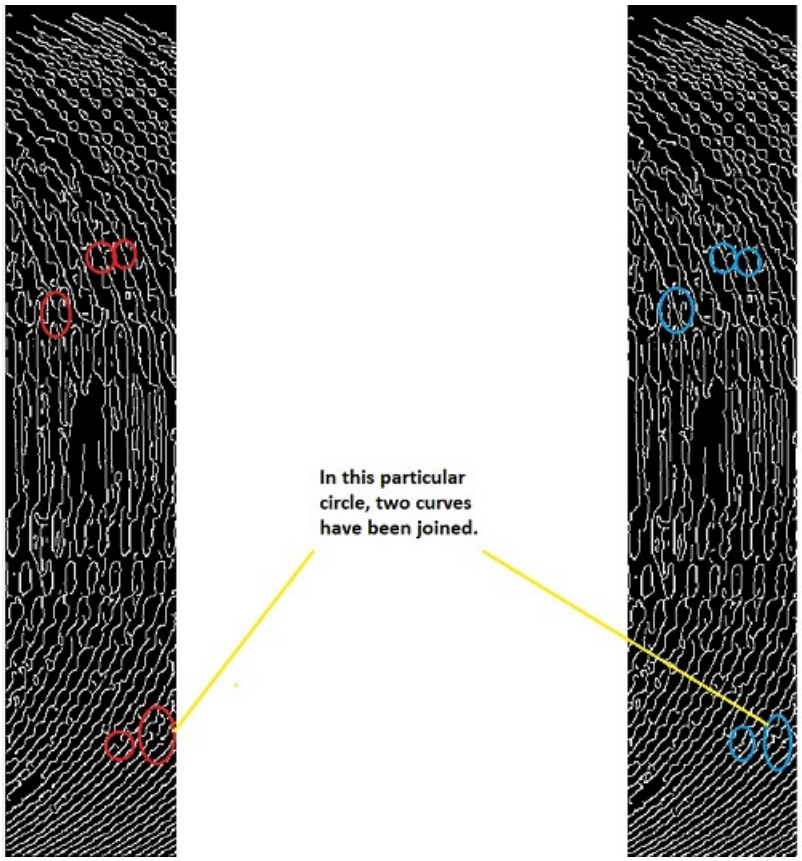
To restore the missing data, image inpainting is applied. The most efficient method for image inpainting is based on exemplar technique.
In exemplar based inpainting, it fills in the target regions by directly copying and pasting patches from source regions, thus image textures are preserved well. The regions near the target site play a major role in this technique. Thus, in this technique a mask has to be provided in order to recover the defect in the image.
In our project, we have used MATLAB's inbuilt function of inpainting to get an output. My algorithm first asks the user to create a mask, the user draws on the image to create a mask and then the image is inpainted.
These are our inpainting results.



3.3 Approach 3: Selecting the Curves to be Joined

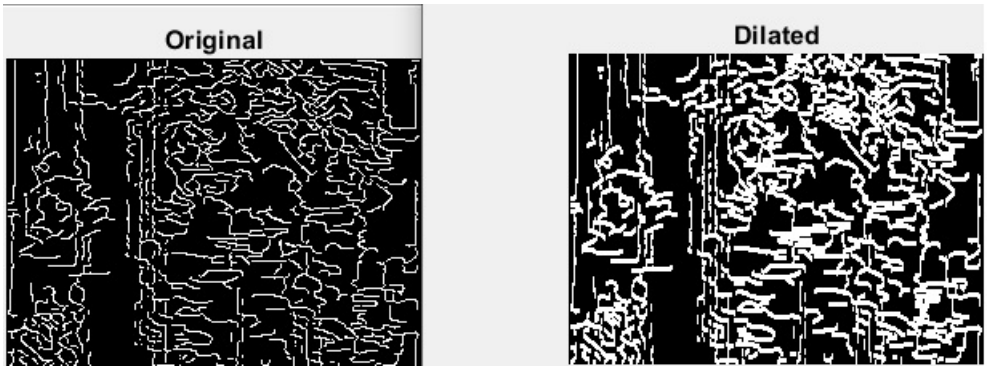
The image obtained by manufacturing processes are generally combination of unidentified curves. To give them an identity, we used bwselect function of MATLAB which gives unique label to all the continuous curves present in an image. It works on the basis of connectivity and relative values of the nearby pixels. This lead us to a new method where we ask the user to select any two curves to be joined, and then our code gives the connected curve. Since the user

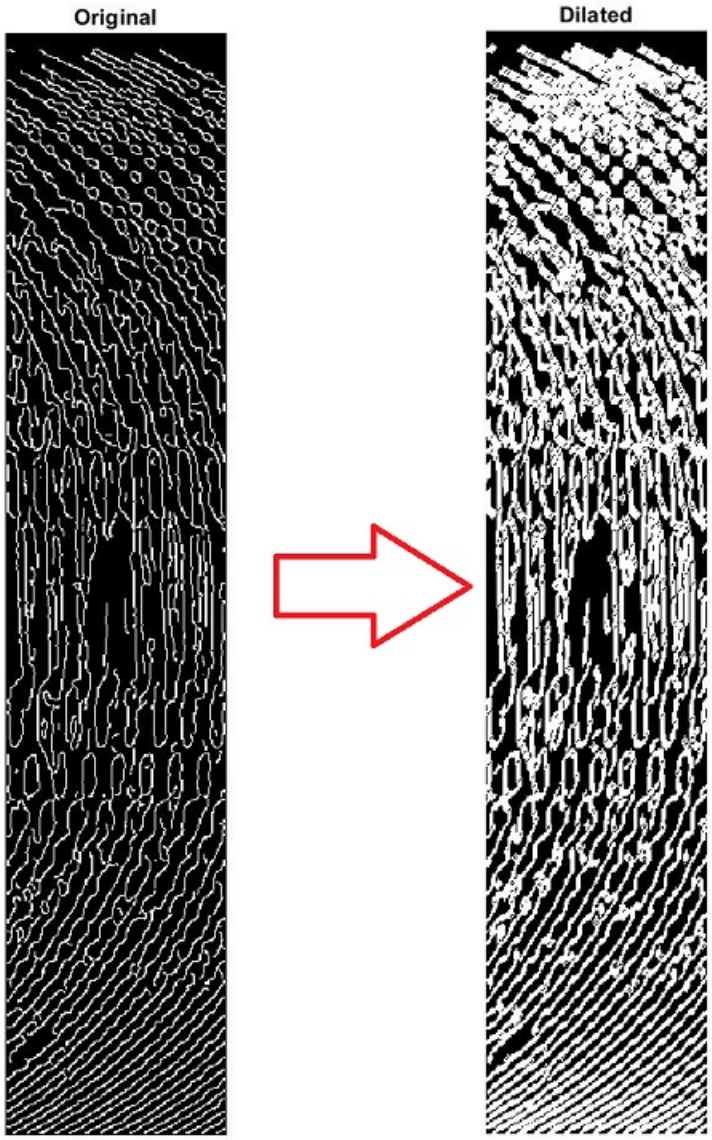
has the best idea about the surface and its properties, this method gave us results.
In the image below, it could be seen that, in total six curves have been joined. Also, their joining is quite efficient ad smooth.



3.4 Approach 4: Morphological Operations:

Morphology is a broad set of image processing operations that process images based on shapes. In a morphological operation, each pixel in the image is adjusted based on the value of other pixels in its neighborhood. Out of different morphological processes, we have used dilation. Dilation expands the image pixels by expanding the pixels of the boundary. Dilation makes objects more visible and fills in small holes in objects. The results obtained were automatic and acceptable.





4 Limitations and Future Plans

In the joining of two curves, the user had to select the two curves that were to be joined. Work can be done in which the curves to be joined have some common property and hence their identification becomes easier leading to their automatic selection and joining.
Though in morphological operations, we were able to obtain products in which the gaps were overcome and hence were acceptable, several iterations may yield better results.

5 Name and Signature of Students

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