Glass Defect Detection and Sorting Using Computational Image Processing

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***Abstract*— Glass proves to be one of the most useful and needful material in our Life. It is the material which is used for making of Optical products ranging from spectacles to window panels. High quality glasses are used in microscopes, telescopes, high end detection systems, etc. Defects arising in the glass can cause errors in the results which may lead to the wrong workings. In case of scientific works the error can be havoc. Here a new Technique is proposed which can localize the defect in the sheet as well as it can assign a numerical value of the damage or defect present in the sheet so that an easy sorting can be carried out.**

***Index Terms*—Glass Defect, Image Processing**

I. INTRODUCTION

Glass defects can reduce the quality and can give undesired results where it is applied. To avoid this Glass is inspected for sorting. The Manual process is very slow, tedious and error prone [1]. An artificial vision-based inspection system has always been a solution to solve this problem. In industries an In-Line scanner is used for scanning the glass texture and software which works in the back end for the defect recognition with help of an image processing technique. Here a new technique is proposed which uses statistics to find the deviation in the glass surface texture using image processing so that an easy sorting can be done in glasses which doesn't meet the perfection.

II. TYPES OF DEFECTS

Once the glass sheet is manufactured, it is sent to the defect detection division of the glass production unit for testing and validation of defects. The various types of defects that can be present in the glass are:

i. Foreign material: This defect has the appearance of a lump. It is an unmelted, opaque material embedded in the glass.
ii. Low-Contrast Defect regions: These defect areas are roughly defined as fairly large, several millimeters in diameter, and relatively dark and/or bright regions that stand out against the background.
iii. Scratches and spots: These are the marks or irregular patches on the surface. These occur mainly during transportation within the factory.
iv. Bubbles and inclusions: It is an air bubble like material trapped inside glass as a defect during its production.
v. Holes and dirt: These are the surface defects which cause major problems for manufacturers, particularly when the production process includes a surface treatment stage.

III. RELATED WORKS

Shin-Min Chao [2] focused on defect detection on low contrast images. This method utilized anisotropic diffusion model. It defines a diffusion system that was flexible for change in the curve of diffusion co-efficient function. It performed smooth procedure for area without fault and sharpened the defected area of the image. Hongxi Zhang[3] proposed an algorithm for detection of defect which was based on Discrete Fourier Transformation (DFT). It also demonstrated and implemented the optimal threshold method to detect cracks, bubble and stone in the glass. This algorithm not only detects but also lo0.calized the region of defect.

IV. THE PROPOSED TECHNIQUE

This proposed technique uses artificial vision for processing the image of the glass scanned by a scanner and applies the statistical calculation to give a value.

1. Procedure

The procedure followed by the technique are :

i. The glass surface image is obtained using a Scanner which scans the glass and records in the computer in RGB Colourspace.
ii. The Image is processed by a software coded in MATLAB which transforms image from RGB to Grayscale and applies statistical calculations to determine the variation of the texture.
iii. The final value determined using the calculations is used for determining the quality of the glass.

2. Software Algorithm

The software which is used to detect the variation of the glass surface texture entirely coded in Mathworks MATLAB.
The software analyses the image in following steps.

i. Image Preparation: The Image is Grayscaled.
ii. Image Processing: The image is then further adjusted which includes contrasting and sharpening the defective part of the image.
iii. Image Thresholding : The Image is thresholded which makes a new image where the defective region gets a higher Grayscale colour and the Background gets a low Grayscale colour which makes a better detection.
iv. Image Storing: The processed image is then read and stored in a matrix for Numerical Calculations.
v. Image Defect Value: The matrix is then processed where the variation of the Pixel Colour is studied.

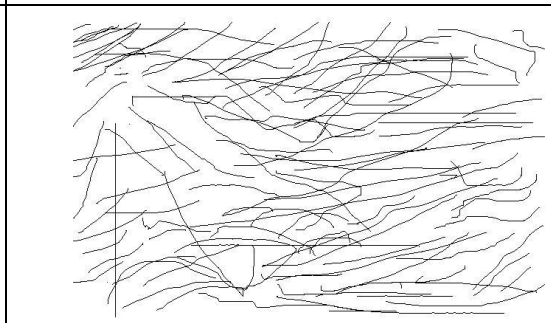
$$F = \frac{\sum \left(X_{i,j} - m\right)^2}{ixj}$$

Where F determines the variance value of the image matrix. i and j are the Height of the Image and the Width of the Image respectively. $X_{i,j}$ refers to the Pixel colour in the i^{th} column and j^{th} row of the image respectively.
The Final value in the 5^{th} step is the resultant quality determining defect value for the respective glass sheet

3. Result

Ideal Glass surface free from all kinds of cracks results 0.00. With the increase in the defects, i.e. change in pixel colour the value starts to increase.

A set of Glass Sheet and their results are demonstrated below:

Defective Sheet	Processed and Thresholded Image	Defect Value
		0.0025
		3.4363e-04
		0.0641

V. CONCLUSION

This technique can detect a small change in the pixel colour. The manufacturers can set a value range for automatic sorting of usable glass sheet. For scientific purposes it can help in determining the best glass sheet for carrying out the work.

VI. REFERENCES

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