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RESEARCH ARTICLE

Study on Various Glass Defect Using Glass Edge Detection Methods

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Abstract— Glass defects are a major reason for poor quality and of embarrassment for manufacturers. It is a tedious process to manually inspect very large size glasses. The manual inspection process is slow, time-consuming and prone to human error. Automatic inspection systems using image processing can overcome many of these disadvantages and offer manufacturers an opportunity to significantly improve quality and reduce costs. In this paper we review various glass defects and the possible automated solutions using image processing techniques for defect detection.

Key Terms: - Defects; methods; processing

I. INTRODUCTION [1]

Digital image processing-

Image processing is a method to convert an image into digital form and perform some operations on it, in order to get an enhanced image or to extract some useful information from it. It is a type of signal dispensation in which input is image, like video frame or photograph and output may be image or characteristics associated with that image. It is among rapidly growing technologies today, with its applications in various aspects of a business. Image Processing forms core research area within engineering and computer science disciplines too [1]. An image may be considered to contain sub-images sometimes referred to as regions-of-interest, ROIs, or simply regions. This concept reflects the fact that images frequently contain collections of objects each of which can be the basis for a region. In a sophisticated image processing system it should be possible to apply specific image processing operations to selected regions. Thus one part of an image might be processed to suppress motion blur while another part might be processed to improve color rendition. Sequence of image processing [9]: In modern sciences and technologies, images also gain much broader scopes due to the ever growing importance of scientific visualization. Examples include microarray data in genetic research, or real-time multi-asset portfolio trading in finance [3].

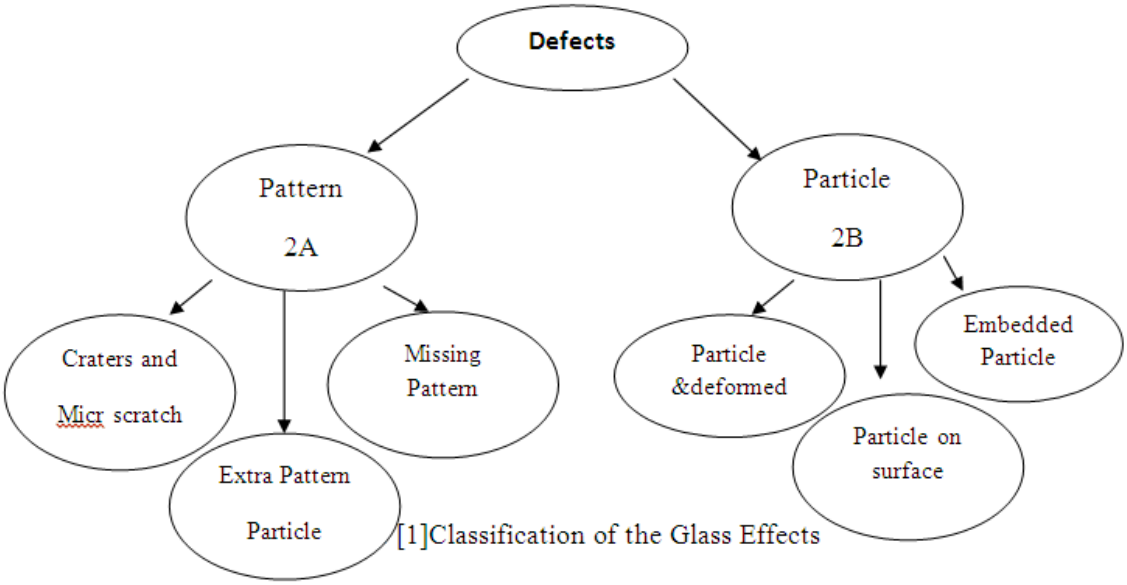
Before going to processing an image, it is converted into a digital form. Digitization includes sampling of image and quantization of sampled values. After converting the image into bit information, processing is performed. This processing technique may be, Image enhancement, Image reconstruction, and Image compression.

Purpose of Image processing

The purpose of image processing is divided into 5 groups. They are:

1. Visualization - Observe the objects that are not visible.
2. Image sharpening and restoration - To create a better image.
3. Image retrieval - Seek for the image of interest.
4. Measurement of pattern – Measures various objects in an image.
5. Image Recognition – Distinguish the objects in an image.

Glass Defects-Glass defects are a major reason for poor quality and of embarrassment for manufacturers. It is a tedious process to manually inspect very large size glasses. The manual inspection process is slow, time-consuming and prone to human error. Automatic inspection systems using image processing and manufacturers an opportunity to significantly improve quality and reduce costs.



[1]Classification of the Glass Effects

Types of Defects on Glass Sheets

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:

Foreign material: This defect has the appearance of a lump. It is an unmelted, opaque material embedded in the glass.

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.

Scratches and spots: These are the marks or irregular patches on the surface. These occur mainly during transportation within the factory.

Bubbles and inclusions: It is an air bubble like material trapped inside glass as a defect during its production.

Holes and dirt: These are the surface defects which cause major problems for manufacturers, particularly when the production process includes a surface treatment stage.

Canny Edge Detection: The purpose of edge detection in general is to significantly reduce the amount of data in an image, while preserving the structural properties to be used for further image processing. Several algorithms exists, and this worksheet focuses on a particular one developed by John F. Canny (JFC) in 1986 [2]. Even though it is quite old, it has become one of the standard edge detection methods and it is still used in research [1].

The aim of JFC was to develop an algorithm that is optimal with regards to the following criteria:

1. Detection: The probability of detecting real edge points should be maximized while the probability of falsely detecting non-edge points should be minimized. This corresponds to maximizing the signal-to-noise ratio.

2. Localization: The detected edges should be as close as possible to the real edges.

3. Number of responses: One real edge should not result in more than one detected edge. With JFC's mathematical formulation of these criteria, Canny's Edge Detector is optimal for a certain class of edges (known as step edges). A C++ implementation of the algorithm has been written, and this will be further described in Section 3. The images used throughout this worksheet are generated using this implementation.

Line Defects: These are the marks or irregular patches on the surface [7]. These occur mainly during transportation within the factory. These can be light (like the marks made by using some tools) or deep (penetrating into the surface of an item and can be felt on touching the surface). These can occur during the process of edge grinding and corner cutting. Example: Scratches and spots, knot line.

Edge defects: Edge defects are the main cause of glass breakage during its production. They can be prevented by detecting them at an early stage and rejecting suspicious sheets. Production line uptime will increase; production costs will be reduced accordingly. Example: jagged edges.

Point Defects: These are the inclusions trapped inside glass as a defect during its production. Example: Bubbles, stone, melt inclusions.

Surface defects: These are the surface defects which cause major problems for manufacturers, particularly when the production process includes a surface treatment stage. Example: Holes and dirt.

Defect Detection Process

Defects are complicated and uncertain. According to appearing areas, defects can be separated into various categories. There are three main modules of this process. Those are image preprocessing module, color space selection module and image segmentation module. The image preprocessing module basically involves formatting of the images in the database as per the requirement to achieve the best results at later stages of research. Next step is to select a color space which best shows the defect in an image thereby reducing the further complexities during its detection during segmentation stage.

II. METHODS FOR GLASS DETECTION [1] [2] [3]

1. A novel method of fabricating a nanopore based on a glass tube for single-molecule detection: A novel nanopore fabrication method is reported by thermally pulling a glass tube in a two-step process. The principle is based on the physical footprint of the phase change of the paraffin sealed inside the glass tube to form a nano-cavity in the broken terminal during the second step of the pulling process. A nanopore with minimum diameter of 40 nm is fabricated after rubbing the terminal to make the channel through it.

2. Crack and Flaw Detection in Glass Objects: To remove the cracks and flaws automated technique Ultrasonic technologies are used. Ultrasonic Technologies is an exclusive provider of patented, cost effective and robust solutions to crack detection in the production environment using patented Resonance Ultrasonic Vibration (RUV) methodology. Model RUV-2.3 will provide a solution quickly, with a throughput of 1 unit every few seconds, and non-destructively detecting mm-size cracks in bare syringes and syringe systems. Our RUV systems utilized in other industries have a highest throughput rate of 2.0 seconds per sample that matches the rate of primary production lines offering a possibility for in-line, real-time crack detection. It is anticipated that RUV modules can be integrated into a syringe production line or testing station and customized according to specific features of the manufacturing environment.

3. Edge Detection Method: Edge detection is a problem of fundamental importance in image analysis. In typical images, edges characterize object boundaries and are therefore useful for segmentation, registration and identification of objects in a scene. In other words we can say that an edge is not a physical entity, just like a shadow. It is where the picture ends and the wall starts. It is where the vertical and the horizontal surfaces of an object meet. It has no width because between a bright window and the darken of the right. Basically edge detection contains the following two parts:-

(1) Using edge operators the edge point set extracted.

(2) Some edge points in the edge point set are removed then obtained edge points are connected to be a line.

Commonly following operators are used for edge detection e.g. Binary morphology, Canny, Log and Differential operator

Binary Morphology: Binary image is also known as black and white image. As we know that object can be easily identified in black background. In this method we can apply binary image and mathematical morphology, so it is known as Binary morphology. The basic idea in this method is that to measure and extract the corresponding shape from image with structural elements having stated form.

Canary Operator: This method is not easily disturbed by noise and can keep the good balance between noise and edge detection. It can detect the true weak edge. For two-dimensional image, canny operator can produce two information including the border gradient direction and intensity

Log Operator: The Log operator is a linear and time-invariant operator. It detects edge points through searching for spots which two-order differential coefficient is zero in the image grey levels. The Log operator is the process of filtering and counting differential coefficient for the image. It determines the zero overlapping position of filter output using convolution of revolving symmetrical Log template and the image.

III. CONCLUSION AND FUTURE WORK

In this paper we have surveyed various Glass defects in image processing with detection methods. The proposed work represents digital image processing or parallel processing methods to identify the defects on glass sheets. In this we have also done analysis of edge detection algorithm to identify the fault on glass i.e. scratches and bubbles. They can help reduce levels of scrap and improve quality, leading to both cost savings and increasing a company's competitiveness. Most commercially available defect detection systems use dedicated electronic circuitry. The increasing power and decreasing cost of processing electronics and the constantly improving performance of imaging sensors has widened the range of applications for which it is possible to configure cost-effective defect detection systems. This trend appears likely to continue. In the future work we will Detect and analysis of defects over glass sheet using Matlab image processing tool and edge detection methods.

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