Different Methods of Defect Detection – A Survey

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Abstract- *In this modern era, visual evaluation is indispensable unit for regulating the product quality in any industry. But in earlier days, these evaluations were performed manually by human scrutinizers. Using human operators, Defect Detection cannot be performed accurately, because of lack of alertness and distraction. In order to overcome these drawbacks, automated visual evaluation systems can be used. Defect Detection is a method where automated visual evaluation systems can be used to control the product quality in an industry to meet its objective. In this paper, we review different Defect Detection methods to detect various defects in an automated way.*

Keywords- Product quality, Defect Detection, Automated Visual evaluation systems.

I. INTRODUCTION

Digital Image Processing is a process of performing various operations and algorithms on digital images to produce enhanced images. Digital Image Processing deals with low contrast images, blurred images, monochrome images and so on. It can be mainly used to extract essential information from the image under consideration. Here, the input can be given in the form of digital images and after processing, the output can be generated in the form of featured or enhanced images. The operations that can be performed on digital images are given in Table 1.

Table 1: Operations performed on Digital Images

Image Acquisition
Image Enhancement
Image Restoration
Color Image Processing
Morphological Processing
Image Compression
Image Segmentation

The three fundamental steps in Image Processing are:

Acquire the input image from the source
Analyze and manipulate the image
Generate the output in an enhanced way

The advantages of Digital Image Processing are given in Table 2.

Table 2: Advantages of Image Processing

Proper data acquisition
Compressed storage
High resolution images
Data quality enhancement
Rapid image transmission
Fast data retrieval

In section II, the basic architecture of Defect Detection is explained. Next, section III gives the various defect detection techniques to detect the flaws in the images. Final section which is section IV concludes the paper.

II. DEFECT DETECTION ARCHITECTURE

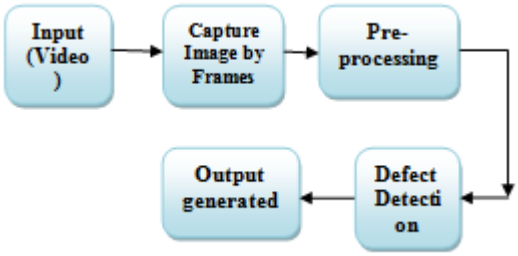

Figure 1: Architecture of Defect Detection

In Figure 1, the basic architecture of Defect Detection is shown as:

a) Initially, the input can be feed in the form of video source.
b) In next step, convert the video into frames and capture each frame in order to apply required image processing techniques.
c) In this step, Pre-processing takes place which includes noise reduction, sharpening and smoothening the image, image conversion from color to monochrome and so on.

d) In next step, Defect Detection techniques can be applied according to the product and its requirement. There are many defect detection techniques available, some are: Fourier Transform, Edge Detection, Wavelet Transform, morphological operations, co-occurrence matrix and so on.
e) In final step, the frames which are converted can again reconverted into video where all the defects can be detected and resolved to produce effective output.

III. DEFECT DETECTION TECHNIQUES

In this section, the various defect detection techniques which were proposed to detect defects in various areas can be reviewed.

In 2011, K.N. Sivabalan et al. adopted a method to identify the defects in various digital images in industries. In this technique, Gabor filter and Gaussian filter is used to eliminate the texture elements in the digital images by isolating the defected area. Then a fast searching algorithm is used to identify the defected pixels and to effectively segment it. The proposed technique is suitable for texture and non-texture images. This algorithm is used to identify the defects in the digital texture image using non-texture methods. The algorithm has proved to be 85% efficient in detecting the defects. However this algorithm is suitable for images which have defects in low intensity levels. So, this algorithm is not efficient for detecting defects in high intensity levels.

In 2012, Wei-chen Li et al. Presented a defect detection based on wavelet decomposition techniques to identify various defects in multi-crystalline solar wafers containing inhomogeneous grain patterns. The defects found in a solar wafer surface generally involve scattering and blurred images with respect to clear and sharp edges of crystal grains in the background. This method uses the wavelet coefficients in individual decomposition levels as features and the difference of the coefficient values between two consecutive resolution levels as the weights to distinguish local defects from the crystal grain background, and generates a better discriminate measure for identifying various defects in the multi-crystalline solar wafers. This method performs effectively for detecting fingerprint, contaminant, and saw-mark defects in solar wafer surfaces. This method can be successful to any types of defects which involve scattered and blurred edges on inhomogeneous solar wafer images. However, micro-crack defect with thin and sharp edges in multi-crystalline solar wafer cannot be detected in this method.

In 2012, Meenakshi Sharma, Gurleen Kaur et al. Proposed a model which provides the texture features and these features together with the color features are used for analysis in classifier such as SVM, KNN & Bayesian. In this method, the detection used will avoid the explicit computation of sign values of the sum of squared differences matrix but the efficiency is small in this method.

In 2012, Md. Maidul Islam et al. Presented model which paves a vital way for automatic revealing of surface flaw during production and packaging. This proposed model includes three levels: initially it focuses on performing various image pre-processing operations on captured tiles image. Secondly, it applies proposed flaw detection methods on tiles image to verify whether tiles are proper or not. Thirdly, it applies defect classification algorithm on captured image to categorize defects. This technique has high computational time and less efficiency.

In 2013, Yadraj Meena, Dr. Ajay Mittal et al. adopted the method that detects the blobs and cracks on ceramic tiles in a faster period of time with greater accuracy. To get a particular realization of proposed defect detection method, the proposed method is applied to a number of flat ceramic tiles images. After that, it is checked whether there is any kind of defects exists in the original image or not by applying the proposed processing operation like image acquisition, enhancement, and noise removal using median filter then edge is detected with the help of edge detector. It only check for Blob and Crack, but does not detect on texture tiles.

IV. CONCLUSION

In this paper, different defect detection techniques were taken and reviewed. Here, various defect detection methods were employed in various areas in order to detect the defects and to improve or enhance the quality of the digital images. It can be concluded that, if all the above discussed approaches were implemented separately, drawback continues. So, the combination of the approaches may give a better and optimal solution.

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