Automatic Inspection System using Image Processing

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Abstract— In manufacturing industries products are often manufactured in large quantities. These products that are manufactured go through quality control process to assess whether the product is properly manufactured or not. Often this quality control process is done manually by workers. This makes the quality control process slow and less accurate as humans take more time to assess the product and cannot find out small details easily. To solve this problem we can use image processing techniques. In this proposed system the products moving on the conveyor belt in manufacturing industries will be assessed for quality using various image processing techniques. An image of a product of ideal quality will be stored in the system. As a newly manufactured product is moving on the conveyor belt a camera will take its picture and compare it with the image of the product of ideal quality which is stored in the system. If the product matches with the stored image in the system, the product will be allowed to move forward on the conveyor belt and if it does not match with the stored image in the system, it will give an alert of defective product and will be discarded.

Keywords: Image Processing, Template Matching, Automatic Inspection, Feature Extraction

I. INTRODUCTION

Image processing is being used in various fields of technology and biotechnology. In image processing different techniques and algorithms are used to process the image. Digital image processing has various advantages over analog image processing. It allows wider range of algorithms to be applied to the input data. Since all images are defined over two dimensions digital image processing may be modeled in the form of multidimensional systems. Through image processing techniques we are able to extract various features from an image. These extracted features can be used in several different applications. In particular, digital image processing is the practical technology for: Classification, Feature extraction and Pattern recognition. In machine learning, the problem which occurs in classification is of identifying to which of a set of categories (sub-populations) a new observation belongs to, on the basis of a training set of the data which contain observations (or instances) whose category membership is known. Feature extraction is dimensionally deducting process. Here, the initial set of raw variables is reduced to additional manageable groups (features) for further processing, while still accurately and completely describing the original data set. Pattern recognition is the process of automated recognition of patterns and regularities in data.

In this paper, applications of various image processing techniques in field of manufacturing have been discussed.

II. LITERATURE SURVEY

1) Jagrti Patel, Meghna Jain and Papiya Dutta, [1] at Asian Journal of Engineering and Applied Technology. The paper presents an approach to automatic detection of fabric defects using digital image processing. In Textile industry, automatic fabric inspection is significant to maintain the quality of fabric. Fabric defect detection is carried out manually with the help of human visual inspection for a long time. This paper proposes an approach to identify fabric defects in textile industry for minimizing production cost and time.
2) Hema L. Chavan., Santosh A. Shinde at International Journal of Advanced Research in Computer Engineering & Technology (IJARCET) [2] proposed a system to measure quality parameters such as dimensions and features of manufactured product inspection is done manually in almost manufacturing industries. Manual assessment is costly, time consuming, sometimes inaccurate and manual assessment for complicated shapes is very difficult. To overcome these problems, quality control and quality management for sensitive industrial product is feasible with the use of image processing techniques.
3) Suzana and Zeljko [3] used the edge detecting technique for defect detection in ceramic tile. The methods were the Canny edge detector method and the Sub-pixel corner locator method. Here first of all Canny edge detector method smoothers the image, then it locate its gradient, does threshold to eliminate insignificant edges and non-maxima suppression. In that way they find edges but also the defects on the images. The Canny edge detector method detected defect were scratches, spots, cracks, blobs and better results.
4) Herve and Lynne [4] used Principal Component Analysis (PCA); PCA is a multipurpose method that analyzes a data table in which are described by a number of inter-correlated quantitative dependent variables. Its major objective is to extract the significant information from the table and to represent it as a set of new orthogonal variables (Principal Components) and to show the pattern of similarity and resemblance of the variables as points in maps.
5) In 'A Detailed Review of Feature Extraction in Image Processing Systems' by Pradeep Kumar Bhatia and Gaurav Kumar [5] proposed that feature plays a extremely important role in the area of image processing. Before getting features, a variety of image preprocessing techniques like binarization, resizing, thresholding, normalization etc. are applied on the sampled image. Later, feature extraction techniques are applied to acquire features that will be useful in classifying and recognition of images. Feature extraction techniques are helpful in different image processing applications e.g. character recognition. As features define the behavior of an image, they show its place in terms of storage taken, efficiency in classification and also in time consumption too.

Sr. No.	Author & Year	Work	Methods Algorithm
1	Jagrti Patel, Meghna Jain and Papiya Dutta	Automatic detection of fabric defects	Digital image processing
2	Hema L. Chavan., Santosh A. Shinde 2016	A system to measure quality parameters such as dimensions	Image processing techniques
3	Suzana and Zeljko 2006	Color and surface effect detection in ceramic tiles	Canny Edge Detector and the sub-pixel corner locator method
4	Herve and Lynne	Extract the significant information from the table	Principal Component Analysis (PCA)
5	Gaurav Kumar and Pradeep Kumar Bhatia	Detailed Review of Feature Extraction in Image Processing Systems	Feature extraction techniques

Table 1: Summary of Literature Survey

III. PROPOSED SYSTEM

A. Problem Statement

One of the most important parts of a manufacturing industry is to maintain the quality of the products it is manufacturing. Physical defects and deformities in products such as bottles, cans, etc. that are manufactured in an industry have to be check manually by workers.

This makes the quality control process slow and less accurate as humans take more time to assess the product and cannot find out small details easily.

B. Methodology

The architecture of this system will consist of various hardware equipments. An image of a product of ideal quality will be stored in the system. Once a product is manufactured it is moved forward on a conveyor belt for further quality assessments. A camera and an infrared blaster (or IR Blaster) will be placed beside the conveyor belt. When a product comes in front of the camera the infrared blaster will detect that product and immediately pause the conveyor belt for few seconds. From a stream of frames being captured by the camera, one frame will be extracted using OpenCV. That frame will be taken as the input image for comparison and classification.

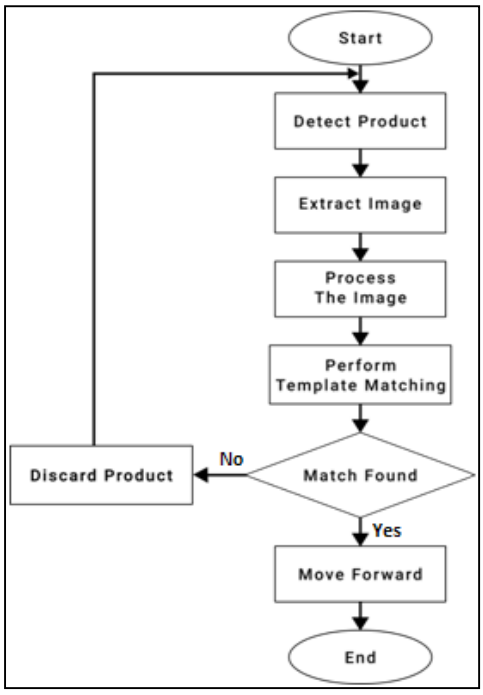

Fig. 1: Flowchart

That image will go through image processing techniques. It will be converted into a grayscale image to lower the amount of processing power required to process it. It will compare that grayscale image with the image of a product of ideal quality that is stored in the system. For this it will use Template Matching.

The method for searching and finding the location of a template image in a larger image is known as Template Matching. It slides the template image over the input image (as in 2D convolution) and compares the template and patch of input image under the template image. It returns a grayscale figure, where each pixel denotes how much does the neighborhood of that pixel match with template.

If the size of input image is (WxH) and template image is of size (wxh), output image will have a size of (W-w+1, H-h+1). Once you got the outcome, you can use cv2.minMaxLoc() function to find where is the maximum/minimum value. Consider it as the top-left corner of rectangle and take (w,h) as width and height of the rectangle. That rectangle is your region of template.

A threshold will be set to define the degree to which the image is supposed to match i.e. how accurately the product has been manufactured. If the image matches with the template image (the image stored in the system) it will restart the conveyor belt. If the image does not match with the template image then an actuator will push that product away from the conveyor belt and discard it.

IV. CONCLUSION

In manufacturing industries products are manufactured in very large quantities. Maintaining product quality and keeping manufacturing costs low is necessary. But through manual quality control done by workers the time taken to assess the products increases significantly and still does not guarantee accuracy in assessment. Through the use of image processing quality control process can be automated. Using template matching it is possible to compare multiple objects with one another. By comparing classification of these products can be done based on their physical dimensions and whether they are manufactured properly or not. Automation of quality control process will decrease the amount of time taken to inspect the product as well as increase the accuracy of assessment. This will also result in saved manual worker costs.

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