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Research Article

CHARACTERISATION OF TABLETS FOR DEFECT IDENTIFICATION USING IMAGE PROCESSING TECHNIQUES FOR QUALITY CONTROL IN PHARMACEUTICAL INDUSTRY

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ABSTRACT

Objective: Our aim is to characterize the parameters for identifying defective tablets from the manufacturing line using image processing techniques.

Methods: Manufactured tablets might have defects such as broken chips, missing tablet, and color variation. Images of tablets are captured using machine vision camera. The features are detected using feature extraction for a tablet without defects and are stored in a database. The stored details are used for identifying defective tablets during manufacturing.

Results: The characteristics such as color, shape, number of pills, area, and perimeter of the normal tablets without defects were extracted.

Conclusion: The defective tablets can be identified by comparing the characteristics stored in the database and can be removed effectively.

Keywords: Image processing, Tablets, Edge detection, Feature extraction, Characterization.

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INTRODUCTION

Quality assurance during packaging stage is of critical importance within the pharmaceutical industry to avoid defective packaging and recalls [1,2]. Drug industry is developing industry in terms of production as well as consumption. Diseases in society have made medicines a part and parcel of our life. Tablets might contain defects, may be broken, there may be missing tablet in a strip, and marketing of these drugs should be avoided. To overcome the above problem, image of the tablets is captured on the conveyor belt using high-resolution machine vision camera. Features are extracted using image processing techniques, and the parameters are analysed for detection of defects. The defective tablets are then removed from the manufacturing line before packaging.

Pharmaceutical companies follow stringent quality measures framed by standard organizations such as ISO and BIS. Defects such as broken tablets, foreign particles, or color variation are possible during manufacturing process that has to be detected before packaging. If the defects are identified before packaging it helps them to retain customer satisfaction and avoid recalls. Manual inspection is usually time-consuming; hence, image processing techniques are employed to automate the inspection process.

A statistical method is proposed where first image is taken and is converted into gray and then to binary further noise is removed for circular-shaped tablets [3]. To identify the damaged tablets after production involves a series of steps involving image enhancement, segmentation, thresholding, filtration, pixel calculation, subtraction, elimination of noise, and region-based statistic to identify the broken capsules [4]. A novel method is introduced for detection of damaged pharmaceutical drugs with center of mass edge detection method [5]. This method involves finding edges of tablets by knowing their center.

Feature extraction method has been proposed for determining basic geometric shapes and to detect the primary color by calculating the ratio of angle of rotation of the object to the area of the object calculated and compared to the predefined ratio to determine the shape of the given object [6]. A new segmentation approach for high-resolution remotely sensed imagery combines the global edge and region information was implemented in the work [7]. The method is an extension of the object detection method that includes new techniques for determination of edge-guided image object detection and region-growing criteria [8].

METHODS

The process consists of identifying the various characteristics of the tablets such as color, shape, size, and number of tablets in the blister. In the production line, when the tablets are produced a tablet with all proper characteristics is chosen. The above said characteristics are identified and stored in the database as template image characteristics. Using these template image characteristics all other tablet images are obtained and compared. The characteristics will be used to identify a defective tablet. The overall architectural diagram is given in Fig. 1.

The proposed method consists of training phase that derives the characteristics for the blisters and followed by testing phase that compares the testing image with the template (trained) image.

The steps for characterization are given below:

1. Input image of the pill blister that is to be characterized is loaded.
2. The tablet blister is converted from RGB to gray scale.
3. The histogram of the gray scale image is produced.
4. The edges of the blister is computed and converted into binary.
5. Mark the boundaries of the tablets.
6. Calculating geo parameters such as centroid, area, and perimeter of each tablet.
7. The centroids are plotted on the respective location for each tablet.
8. With the binary image of the tablet blister, the shape is characterised as circle, rectangle, or arbitrary.
9. From the input image, the color of the tablet pill is detected for each tablet in it using centroid point.
10. A no. of tablets are calculated from the tablet blister using binary image.

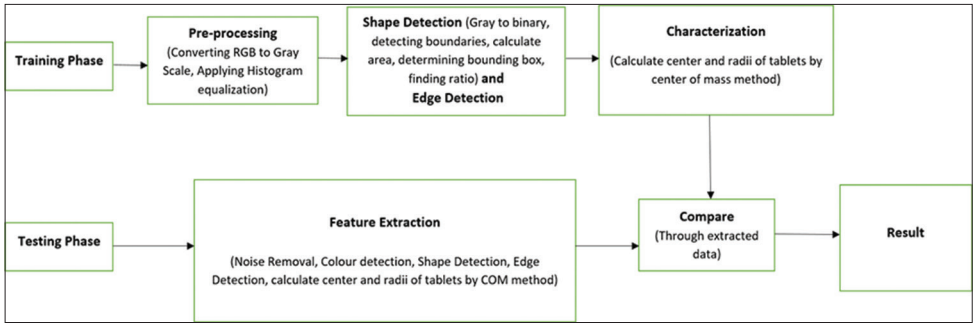

Fig. 1: Architectural diagram for characterization of pharmaceutical blisters

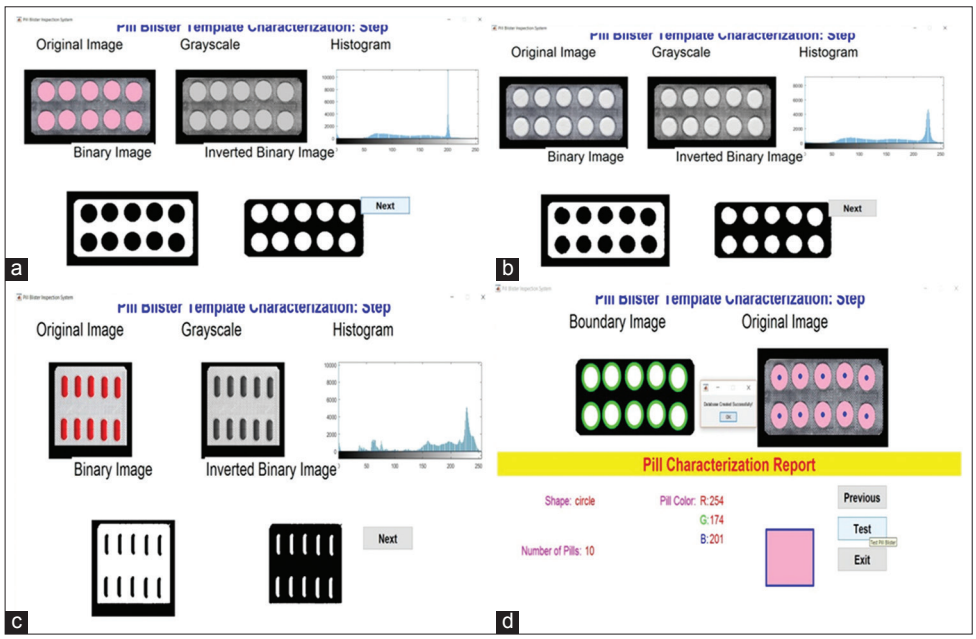

Fig. 2: (a-c) Basic steps for characterization, (d) characterization report

11. Create a database to store pill id, shape, number of pills, red, green, blue, centroid, area, and perimeter.
12. Now the tablet blisters that are to be tested can be loaded and compared with the created database.
13. This methodology, results in identifying shape mismatching, tablet missing, color mismatching, and conclude whether the pill blister is faulty or not.

The above steps are implemented in MATLAB R2013a and the results are shown below.

RESULTS AND DISCUSSION

The above steps were followed to detect the characteristics of blisters as shown in Fig. 2a-d. The basic conversion of original image to inverted binary image is shown in Fig. 2a-c followed by displaying of characterization report in Fig. 2d.

The following four samples were used to train the system as given in Fig. 3a-d. The output from the above system is shown in Table 1.

The first parameter reveal the color of the tablets, followed by shape that can output circle or rectangle, area, perimeter, and number of pills in the blisters.

CONCLUSION

The results from the proposed work can be used in the production line of the pharmaceutical organization. The characterization module described can effectively store the various required characteristics that can be used as a template for identifying the defects. Defect of the tablets are identified using edge detection along with shape detection and color detection so that the efficiency is increased to greater extend. The accuracy of the model was 99% with a good precision and recall values.

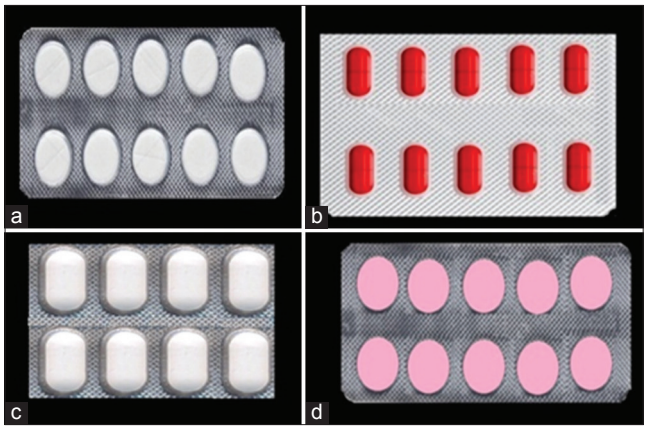

Fig. 3: (a-d) Blister samples used for training

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Table 1: Characterization output from pharmaceutical blisters

Pill No.	Color			Shape	Area	Perimeter	Number of pills
	R	G	B				
1	225	225	225	Circle	4350	239.25	10
2	254	174	201	Circle	5005	247.85	10
3	181	1	0	Rectangle	1864	208.68	10
4	237	235	236	Rectangle	7273	327.17	8

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