

Application of Digital Image Processing in Drug Industry

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Abstract: Digital Image Processing is a very vast field It has many applications in every field and one such application is in drug industry. Drug Industry is leading industry. Manufacturing process in drug Industry is increasing day by day as we are dependent on these medicines. But these medicines might be defected, tablets may be broken, there may be missing tablet in a strip and consumption of such drugs might be dangerous. This paper shows different methods in digital image processing technique to find the defects in tablets. Four methods are used in order to detect the defect in tablet strip.

Keywords: Digital Image Processing, Morphology opening, Template Matching, Mathematical Manipulation, Euler's number

I. Introduction

Digital image processing techniques and algorithms are applied on images in order to remove error. In this paper, different digital image processing techniques are used to detect the defect in tablet strip [1][2][4][5][6][7]. Such defected tablets are harmful to consume and may have many side effects. The inspection process is effective to detect the defects in tablets. Four techniques are used that is morphology operation(MO), Template Matching(TM), Mathematical Manipulation(MM) and Euler's Method(EM) to defect the different defects in tablet strip. All the techniques are implemented in MATLAB 10. Figure 1 shows such defected tablet strips.

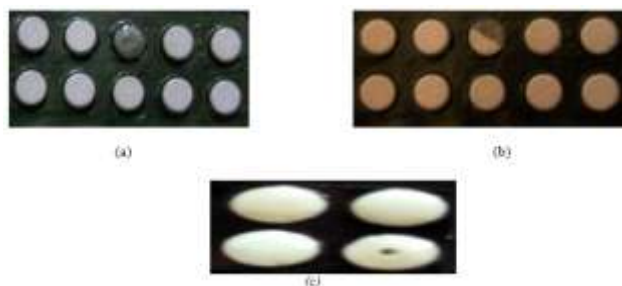


Figure 1 Different Tablet strips with defect (a) Missing Tablet (b) Broken Tablet (c) Hole in Tablet.

II. Methodology

- Morphology Operation technique(MO)
- Template Matching(TM)
- Mathematical manipulation(MM)
- Euler's Method(EM)

Morphology Operation

Morphological operations are affecting the form, structure or shape of an object. Applied on binary images (black & white images – Images with only 2 colors: black and white). They are used in pre or post processing (filtering, thinning, and pruning) or for getting a representation or description of the shape of objects/regions (boundaries, skeletons convex hulls). Morphological operations apply a structuring element to an input image, creating an output image of the same size. In a morphological operation, the value of each pixel in the output image is based on a comparison of the corresponding pixel in the input image with its neighbors. By choosing the size and shape of the neighborhood, you can construct a morphological operation that is sensitive to specific shapes in the input image [1][3][8][11].

Morphology is of following types:

- Dilation:** Dilation allows objects to expand, thus potentially filling in small holes and connecting disjoint objects.
- Erosion:** Erosion shrinks objects by etching away (eroding) their boundaries.
- Opening:** Morphological opening is used to remove small objects from an image while preserving the shape and size of larger objects in the image. Morphology opening is simply erosion followed by dilation. The opening has the effect of removing objects that cannot completely contain the structuring element.
- Closing:** Closing is opening performed in reverse. It is defined simply as dilation followed by erosion. Erosion using the same structuring element for both operations.

Template Matching (TM)

Technique used in classifying objects. Template matching techniques compare portions of images against one another[1][9][10][13]. Sample image may be used to recognize similar objects in source image. If standard deviation of the template image compared to the source image is small enough, template matching may be used. Templates are most often used to identify printed characters, numbers, and other small, simple objects. For example original image is of tablet packet containing ten tablets. Like morphology operation image is first converted into gray and then to binary. The binary image is then filtered in order to remove noise and edges are detected using canny edge detection. A template is selected and is compared with rest of the tablets In this way defected tablet can be found. The Template Matching block finds the best match of a template within an input image. The block computes match metric values by shifting a template over a region of interest or the entire image, and then finds the best match location.

Mathematical Manipulation (MM)

MM is used to find the defect in tablets.MM calculates the mathematical values. No. of tablets are calculated which helps to determine the correct figure in a tablet strip. Counting can also help to find the pharmaceutical company. They can simply discard the strip containing less or greater no. of tablets.

Euler's Method(EM)

Tablet which is having any hole is detected by using Euler's number of binary image. Euler's number is used to detect the holes in an object; we used this function in tablets having holes. Euler's number is the number of objects minus the number of holes [12].

$$Eu=N-H \dots\dots\dots(1)$$

Where Eu,N and H are Euler's number, number of objects, number of holes respectively.

Also, $H=N-Eu \dots\dots\dots (2)$

Therefore, from the above equation number of holes is equal to the number of objects minus the Euler's number. For finding Euler's number, image should be binary. Therefore, image is converted into binary. Euler's number tells whether tablet is having any hole or not. After finding Euler's number, position of tablet is detected. Also connected component of binary image is detected. Connected components in a binary image are a set of pixels that form a connected group. From this we also get image size, list of pixels belonging to each connected component. If the Euler's number is negative, it indicates that the number of holes is greater than the number of objects. Euler's number will detect whether the tablet is having any hole or not. After finding the presence of hole next step is to detect the position of hole. In order to detect the position of hole, we use simple arithmetic operation. Tablet with hole and without hole are subtracted.

III. Proposed Work

The proposed work is divided into four parts, that is

- a. Morphology Operation technique(MO)
- b. Template Matching(TM)
- c. Mathematical manipulation(MM)
- d. Euler's Method(EM)

All the above techniques are summarized in one block diagram as shown in figure 2

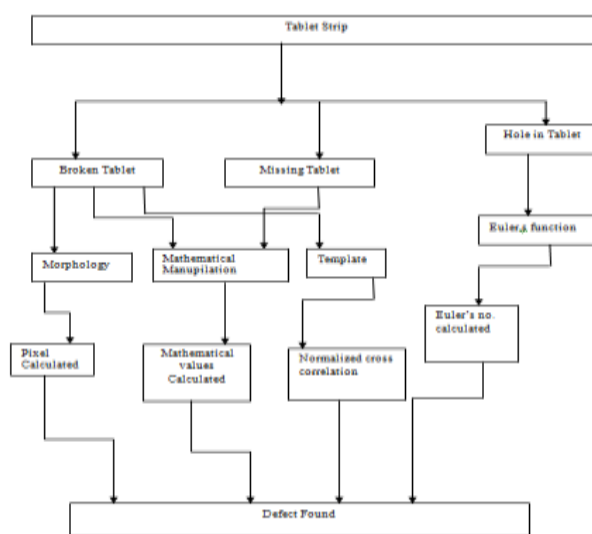


Figure 2 Block Diagram

It is clearly shown in figure 2 that MO detects the broken tablet in tablet strip, TM, MM detects broken as well as missing tablet in tablet strip and EF detects hole in tablet strip.

a) Steps for MO

1. Capture an image of a tablet packet without any defect.
2. Convert this image into gray image.
3. Convert gray image into binary image
4. Apply morphology opening on binary image. Morphology opening will remove noise from the image.
5. Dilate the opened Image. Dilation will expand the image and will make the image big.
6. Calculate the no. of pixels of binary image.
7. Now capture the same tablet packet with broken/missing part.
8. Apply the same process that is applied on tablet packet without any defect.
9. When defected packet is found, beep will be generated.
10. Subtract the two images
11. Missing part of tablet and position of defect is obtained.
12. Filter it by using morphology opening technique which removes the noise.

b) Steps for Template Matching

1. Read an template image (defected or broken tablet).
2. Crop the image
3. Read the image of defected tablet packet.
4. Crop the image
5. Use normalized cross correlation to detect the position of defected tablet
6. Position of defected tablet found.

c) Steps for MM

1. Capture the image of tablet Strip
2. Convert the image into gray image
3. Convert gray image into binary image
4. Apply Morphology Opening on binary image. Morphology opening will remove noise from the image.
5. Boundaries of the output are detected after pre-processing.
6. After this process determine the roundness of the tablet, Find area and perimeter of each tablet
7. After calculating area and perimeter, find the metric. Metric closer to 1 indicates that tablet is not broken or is completely round.

d) Steps for EM

1. Input image is first pre-processed. Pre-processing involves conversion from RGB to gray image then to binary image. Binary image is then cleaned using morphology opening.
2. Pseudocolor is applied on opened image.
3. Connected objects is found.
4. Find the Euler's number.
5. If Euler's no. is equal to zero then the tablet is without hole else tablet is with hole and will ring beep.
6. Boundaries of the output are detected after pre processing.
7. After this process determine the roundness of tablet, find area and perimeter of each tablet.
8. After calculating area and perimeter, find the metric. Metric closer to 1 indicates that tablet is not broken or is completely round.

IV. Results And Discussion

Simulation Result of MO

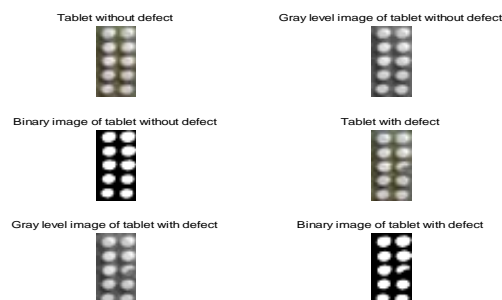


Figure 3 Pre-processing of Tablet Strip

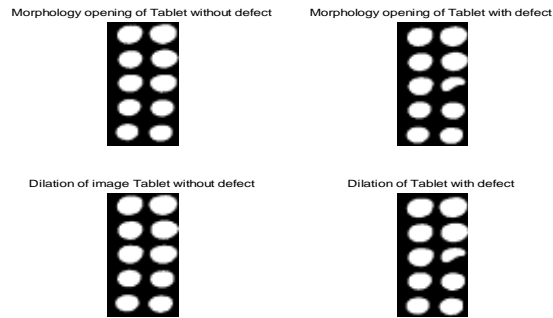


Figure 4 Morphology Opening process

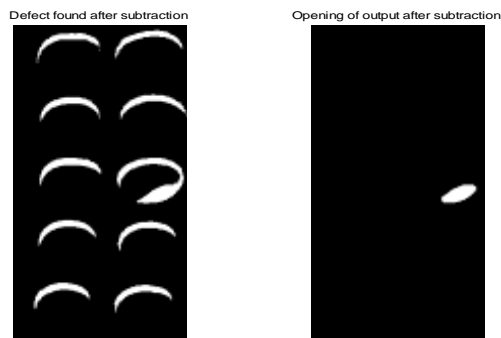


Figure 5 Defect detected

It is clearly shown in figure 3,4,5 how defected tablet is detected in tablet strip. At the end of program command window displays following information.

```
Countwithoutdefect =  
342776  
  
Countwithdefect =  
348478  
  
TABLET REJECTED
```

Simulation Result of TM



Figure 6 Tablet strip with broken part

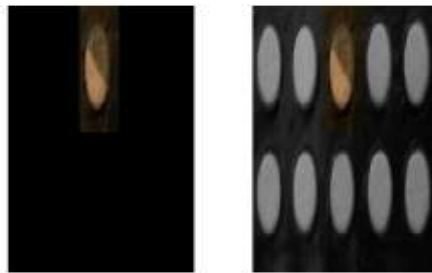


Figure 7 Broken tablet detected

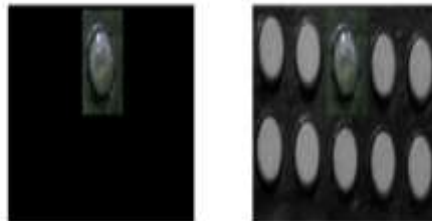


Figure 8 Missing Tablet detected

It is clear from figure 7 and 8 that template matching detects broken as well as missing tablet
Simulation Result of MM

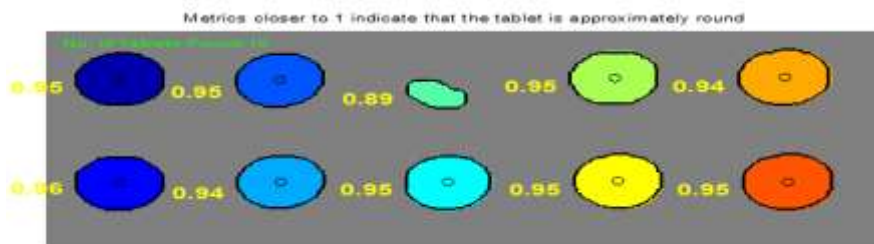


Figure 9 Shows defect detected by using MM

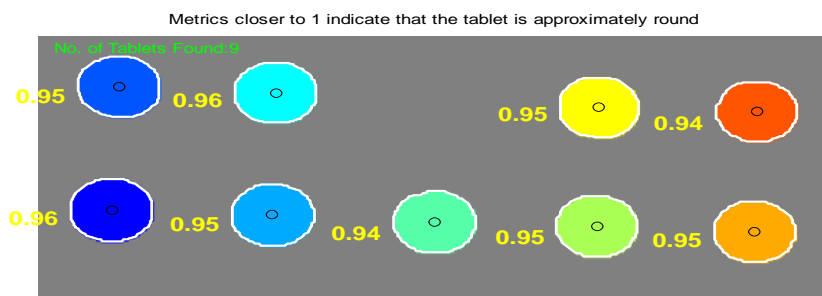


Figure 10 Missing Tablet detected in tablet strip

Simulation Result of EF

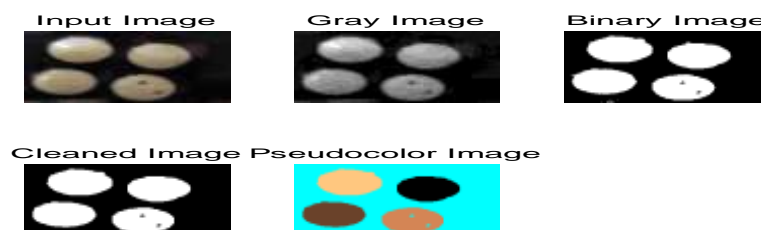


Figure 11 Holes in Tablet Strip



Figure 12 Message indicating presence of hole

```
cc =
Connectivity: 8
ImageSize: [336 382]
NumObjects: 4
PixelIdxList: {[10871x1 double] [11555x1
double] [10667x1 double] [10812x1 double]}

eu =
2
h =
2
```

At the end of program command window is displayed with above information.

V. Conclusion

This paper presents the application in drug industry using digital image Processing technique. It is implemented on MATLAB 10. Four techniques are used that is MO, TM, MM and EF to defect the different defects in tablet strip. MO detects the broken tablet in tablet strip, TM, MM detects broken as well as missing tablet in tablet strip and EF detects hole in tablet strip.

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