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Research paper

Defect Detection in Pharma Pills Using Image Processing

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Abstract

In this work, methods for finding defects in pharma pills are proposed. Here pills are classified as tablets and capsules, further tablets are classified based on their shapes as oval shaped and round shaped tablets. Capsules are classified based on their colors in this three colors are considered that is red, green and blue double colored capsules like white-blue and white-brown are considered. While packing there may be some visible defects in the pills. This will vary the dosage of pills, manual inspection would be too tedious and less accurate so here some methods to identify these defects are proposed. Defects such as variation in count of tablets, cracks, breaks or variations in the size and shapes of tablets are considered. In capsules absence of capsule, variation in the size and shape of the capsules or presence of any other colored capsules are considered. These methods successfully detect number of non-defected tablets and number of defected tablets, and hence the non-defected tablets can be reused and defected tablets can be discarded.

Keywords: *Capsules; Defect; Image processing; Pharma pills; Tablets.*

1. Introduction

In Pharmaceutical industry, drugs are to be produced on very large scale. Now-a-days, medicines have an important role in human life. These drugs may be broken when manufactured. There may be side-effect of these defected drugs due to variation in dosage when consumed. The manufactured drugs should be properly inspected before reaching to the public, so that they do not cause any side-effects. Hand-operated inspection of these drugs that are manufactured on massive scale takes a lot of time and hence it is a challenging task. So, here some automation methods for identifying defects in pills using image processing are proposed. Image processing is a method to perform some operations on an image, in order to get an enhanced image or to extract some useful information from it. It is a type of signal processing where input is image and output may be image or characteristics or features associated with that image. Digital image processing techniques help in manipulation of the digital images by using computers.

In this paper pills are classified into two categories such as tablets and capsules. Tablets are again classified into two categories according to their shapes as oval shape and round shape. Capsules are again classified into several categories based on their colors as red, green and blue some double colored combinations are considered like white-blue and white-brown. Here some methods are proposed for identifying defects like missing tablets and capsules or miss match in color of the capsules also in tablets like round and oval shaped tablets defects such as cracks and breaks are identified.

2. Related Work

Edge detection can successfully detect edges of each tablet [1] but in this method the lines given for breakage is also detected as defect in shown below figure. This method successfully detects number of tablets in the tablet sheet and also the defects in the tablets. This works almost well for round tablets but fails for oval shaped tablets, since for this the line for breakage gets highlighted.

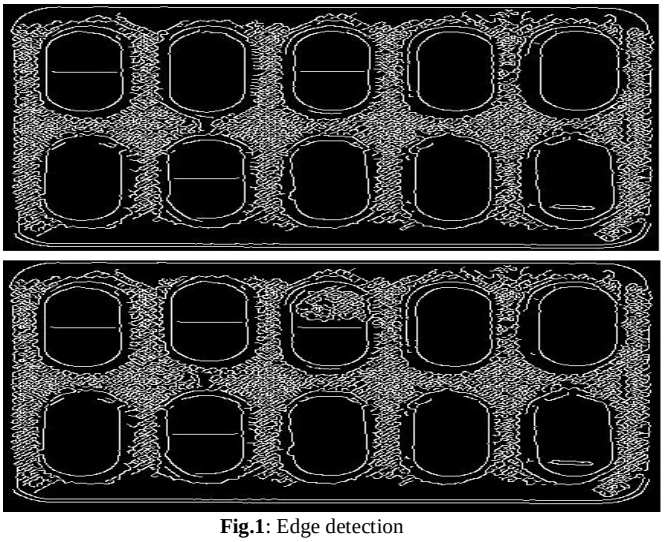


Fig.1: Edge detection

Enhanced Feature Extraction Technique for Detection of Pharmaceutical Drugs [2] in this method, the circles of blisters is detected as shown in below figure2. Even if the tablet is absent and the blister is clear then the blisters get detected as tablet. [3] in this the

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edges of the blisters are detected and compared if the tablet is half present or if the tablet is absent then only the blisters get detected.

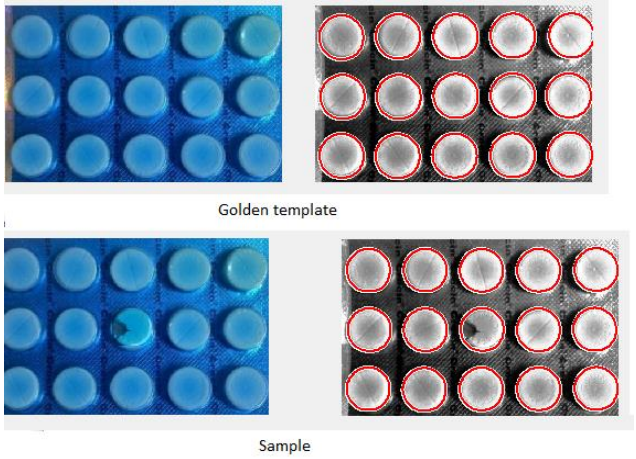


Fig.2: Circles detection

Huvaida Manzoora, Yogeshwer Singh R [4] In this work area and perimeter of circles are found. Then the metric value is calculated using the formula.

$$M=4*\pi*Area/Perimeter^2. \quad (1)$$

Where, $Area=\pi*r*r$.
$Perimeter=2*\pi*r$.
M- metric, r- radius of a circle
Metric value will vary a lot. Empty blisters and blisters with half or broken tablet will also get same metric values as shown in below figure3.

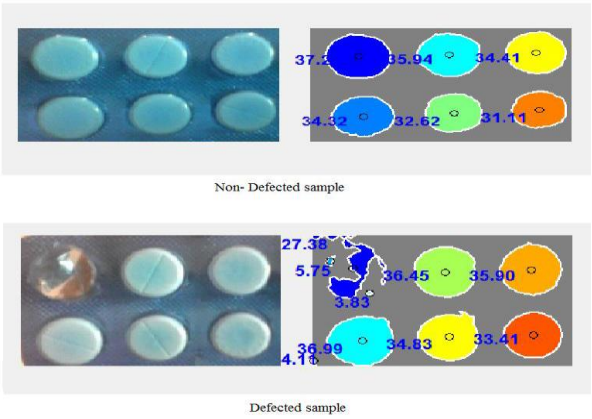


Fig.3: Metric values for circles.

3. Problem Definition

Goal of the proposed method is to successfully identify the defects in the pharma pills using images. There are some methods like human inspection and automation inspection. Human inspectors check the quality of the pharma pills manufactured at pharma company. This process involves a worker monitoring a conveyor belt of capsules and removing any defective product. But its less efficient and its not consistent, depends on environment and mood of the inspectors. Requires monthly investment and hence costly. In automation inspection there are two methods again that are x-ray scanning and a image processing system. In x-ray scanning a stream of x-ray light is passed through tablet sheets it can detect weather tablet is present or not in the blister, it cannot detect other defects like breakage cracks or if the tablet is half present. But it is cheaper, also one time investment. There is another system which uses image processing which is better than x-ray scanning and human inspection, but requires cameras of high resolutions and also has complex coding hence its costlier and less efficient. In these paper four efficient methods like "Segmentation and comparison for oval shaped tablets", "classifying image as fore ground and background image for round tablets", "color detection for single colored capsules", "k-mean clustering for double colored capsules".

System Assumptions: To get better results the image standard is set. The dimension of the image should be 574*424 with 96 pixels. The image of the tablet should be taken with a camera of minimum 3mp.

3.1. Segmentation and comparison for oval shaped tablets

A tablet sheet image without any defect and with correct number of tablet is selected as golden template image. Initially golden template image is converted to binary image and is segmented such that the total number of segments is equal to number of tablets in the tablet sheet, then the sample is given to the system. The sample is converted to binary image and segmented. The total number of segments of sample and golden template are compared to get total number of tablets to be present in the sample. A random segment from golden template is selected by the system and compared with each fragment of the sample if the difference is more then the tablet is detected as defected. The total number of fragments gives the total number of tablets present in the tablet sheet. The difference range is adjustable, so it allows company to specify their own ranges. This helps to get more flexible and accurate results.

Notations:
g: golden template image.
gb: binary image of golden template.
gn: number of tablets/segments in the golden template.
r: randomly selected segment of golden template
s: tablet sample to be tested.
sb: binary image of sample.
sn: number of tablets/segments in the sample.
sd: sd=0, number of defected tablets in sample.

Algorithm-1:

Input: golden template image<g>.
1. g is converted to gb.
2. gb is segmented and total segment is gn.
3. Input: sample to be tested<s>.
4. s is converted to sb.
5. sb is segmented and total segment is sn.
6. If gn == sn.
7. sample has correct number of tablets.
8. else
9. (gn-sn) tablets are missing
10. end if.
11. select a random segment r from golden template.
12. for each segment si in sn.
13. if r==si
14. not defected.
15. else
16. defected tablet.
17. sd=sd+1
18. number of non-defected tablet is (sn-sd).

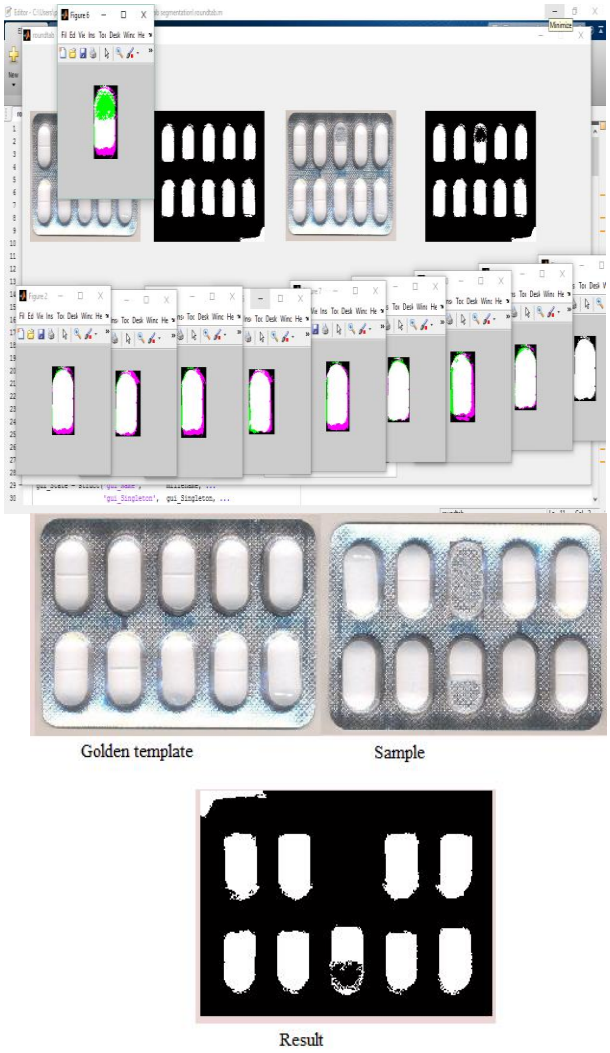


Fig.4: Segmentation and comparison for oval shaped tablets detection.

3.2. Classifying image as fore ground and background image for round tablets:

Many image processing techniques are used to process golden template and sample. The processing techniques in order are 'Structural image', 'Morphological operations', 'Reconstruction of image' and 'regional maximum'.

Structural image: structural image are standard images. This are used to extract particular shapes with sizes in image. Here the circular shaped structure with the radius equal to radius of the tablet is created and checked for the presence of circles with specified radius. This highlights the tablets and hence separates it as foreground image eliminating its background

Morphological operations: To extract exact shape morphological operation like erosion and dialation are performed on the image. Erosion is used to eliminate extrusions in the image. Normally erosion shrinks the shape. Dialation is used for joining the images, repairing breaks and intrusion. Normally dialation enlarges the shape.

Reconstruction: it extracts the marked objects. Find bright regions surrounded by dark pixels, detect or remove objects touching the image border, detect or fill in object holes, filter out spurious high or low points, and perform many other operations. Essentially a generalization of flood-filling, morphological reconstruction processes one image, called the marker, based on the characteristics of another image, called the mask. The high points, or peaks, in the marker image specify where processing begins. The peaks spread out, or dilate, while being forced to fit within the mask image. The spreading processing continues until the image values stop changing.

Regional maximum: This function is used to extract maximum bright regions in the image. Then image is segmented to extract individual tablets and every tablet is compared with golden template.

Golden template image is processed and number of tablets is detected. The same procedure is performed on the sample, if there is any minute defects like cracks in the tablets the tablet does not get detected and it is treated as defected. The total number of tablets in sample is compared with number of tablets in golden template to get number of defected and non-defected tablets.

Notations:
g: golden template image.
gp: processed golden template.
gn: number of tablets in the golden template.
s: tablet sample to be tested.
sp: processed image of sample.
sn: number of tablets in the sample.
sd: sd=0, number of defected tablets in sample.

Algorithm-2:

Input: golden template image<g>.

1. g is processed to gp.
2. gn the total number of tablets in golden template.
3. Input: sample to be tested<s>.
4. s is processed to sp.
5. sn the total number of tablets in the sample.
6. If gn == sn.
7. sample has correct number of tablets.
8. else
9. sd=sd+1 tablets are missing and defected.
10. end if.
11. sn is number of non-defected tablets.

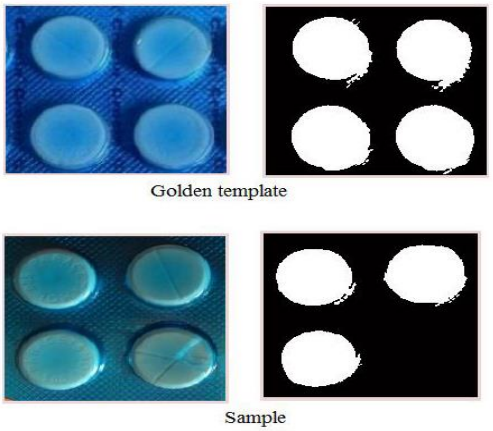


Fig.5: Classifying image as fore ground and background image for round tablets

3.3. Colour detection for single colored capsules

Here capsules are differentiated based on colors. This successfully detects red, green and blue capsules with more accuracy and speed. This method subtracts all other colors from the image and retains only specified color. Once the color is detected it is easy to find its area. Average area of capsules is found and a capsule

whose area deviates to a large extent from the average is detected as defected.

Notations:
g: golden template image.
gn: number of tablets in the golden template.
s: tablet sample to be tested.
sn: number of tablets in the sample.
sd: sd=0, number of defected tablets in sample.

Algorithm-3:
Input: golden template image<g>.
1. extracts region with only red color and area is detected.
2. gn the total number of equal red region.
3. Input: sample to be tested<s>.
4. sn the total number of tablets in the sample with equal region.
5. If gn == sn.
6. sample has correct number of tablets.
7. else
8. sd=sd+1 tablets are missing and defected.
9. end if.
10. sn is number of non-defected tablets.

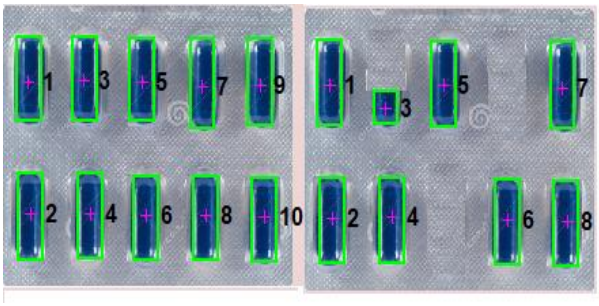


Fig.6: Blue color based detection



Fig.7: Green color based detection.

3.4. K-mean clustering for double colored capsules

The capsules with double colors are considered here. In this color based segmentation called K-mean clustering is used. From CIE XYZ tristimulus values L*a*b* color space is derived, where the 'L*' space consists of luminosity layer. The color falling along red-green axis indicates chromaticity-layer 'a*' and the color falling along blue-yellow axis indicates chromaticity-layer 'b*'. 'a*' and 'b*' layer has all of the color information. According to K-mean clustering all the objects has location in space Clustering can be used to separate group of objects. The partition find by k-means clustering is such that within the clusters the objects are close and between the clusters objects are as far as possible. This requires distance between two objects and number of clusters to be specified. The objects are pixels with 'a*' and 'b*' values since it has the color information. K-means is used to cluster the objects into three clusters using Euclidean distance metric.

Two samples are considered for double colored. That are white-blue and white-brown.The golden template image is input to the system and k-mean clustering is applied. It gives the number of equal white area present in the sheet. Then the golden template is given to the system k-mean clustering is applied to the sample the results of sample and golden templates are compared.

Notations:
g: golden template image.
gw: number of white regions in the golden template.
gb: number of blue region in the golden template.
gn: total number of capsules in the golden template
s: tablet sample to be tested.
sw: number of white regions in the sample.
sb: number of blue region in the sample.
sn: total number of capsules in the sample.
sd: sd=0, number of defected tablets in sample.

Algorithm-4:
Input: golden template image<g>.
1. extracts number of equal white regions gw.
2. extracts number of equal blue regions gb.
3. total number of tablets in golden template gn.
4. Input: sample to be tested<s>.
5. extracts number of equal white regions sw.
6. extracts number of equal blue regions sb.
7. total number of tablets in golden template sn.
8. If gn==sn and gw==sw and gb==sb
9. no defects.
10. else
11. defected tablets.
12. gn

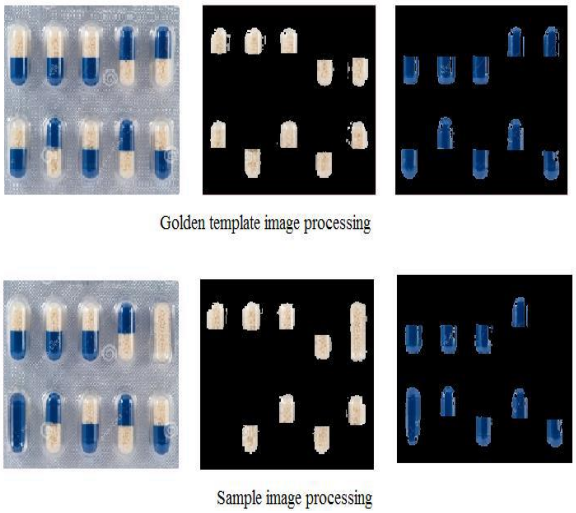


Fig.8: K-mean clustering for white-blue capsules

4. Conclusion

Pharmaceutical drugs are the need of Human life. These are used to cure disease. Some diseases need proper care and medication. So, the inspection of these drugs should be done. There are a lot of automated tools for this inspection. The proposed method easily detects broken and missing tablets. The color detection method can detect single colored and double colored capsules/tablets in the blister by. Thus we can say that both the methods are easy to implement and showing their results precisely. Both this methods are implemented using different tablet strips and capsule blister. In all cases, they give good results.

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