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Utilization of Digital Image Processing In Process of Quality Control of The Primary Packaging of Drug Using Color Normalization Method

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Abstract. In the process of quality control, accuracy is required so that the improper drug packaging is not included into the next production process. The automatic inspection system using digital image processing can be applied to replace the manual inspection system done by humans. The image captured from the vision sensor is RGB image which is then converted into grayscale. The process of converting RGB image into grayscale image is performed using the color normalization method to spread the data of RGB colors at each pixel. From the software of image processing using the color normalization method that have been created, it shows grayscale images on the drug object which have degrees of gray higher than the grayscale image section of the background when the degree of the R, G or B color of drug is higher than the degree of the R, G, B color on the background of packaging. The determination of threshold value indicates that the binary image of the drug is white and a binary image of the background of drug packaging is black.

Keywords: Color Normalization, Object of Drug, Thresholding, Object Counting, Outside Corners and Inside Corners.

1. Introduction
In the process of quality control, accuracy is required so that the drugs with improper or failed packaging are not included to in the next production process, e.g. the process of secondary packaging. However, the process of quality control which is done manually by humans has a weakness because it cannot be done continuously due to physical fatigue, added with problems of accuracy that allows some failure in primary packages that escapes the quality control process. Therefore, automatic inspection system can be applied to replace the manual inspection system done by humans.

Computer vision is mostly applied in many industries especially those requiring automatic inspection of the goods produced at each stage of the production line [1]. Computer vision is an automatic process integrating a large number of processes for visual perception, such as image acquisition, image processing, classification, recognition, and making a decision [2]. This research discusses about the use of digital image processing using color normalization method use to perform a visual inspection of primary packaging of drug blister shape using webcam as a sensor. Using the
model of normalization, an object with a particular color can be detected and free from the influence of changes in light intensity from the outside [3].

2. Method
The steps implemented in this research are: environmental preparation, image capturing, grayscale, thresholding, objects counting, objects separation as shown in the flowchart in figure 1.

3. Results and Discussion
The environment of image capturing of the object needs to be conditioned so that the image of the object gained achieve ideal conditions. The environmental setting includes: a conveyor belt as background object is colored in contrast to the object, the lighting is set in order to have sufficient illumination and there is no influence of outside light that can disturb the object or the camera when the image capture process, reducing interference around the object. The velocity of the conveyor is set so that the object can be captured as well by a camera. It is set on 0.03 m / sec with PWM duty cycle of 230. Here the speed of the processing capture as well as the image processing per frame are affected by the processing speed of a processor.

In the stage of picture taking, image with a size of 320 x 240 pixels is taken using a webcam placed on the top of the object. Before carrying out to image acquisition, camera height position is set in such a way so that all areas of package can by a camera properly.

![Figure 1. Research Steps](image)

![Figure 2.](image)

Images taken from image capture process generate an image in the form of an RGB image. To simplify the model of image, the RGB image to be converted into a grayscale image using the colors normalization method to parse the RGB data at each pixel. Colors Normalization in one method to determine the intensity of certain basic color of an image grayscale obtained from the comparison between certain base color intensity with a total intensity in each color channel by using the following equation:

$$r = \frac{R}{R+G+B}, \quad g = \frac{G}{R+G+B}, \quad b = \frac{B}{R+G+B}$$

(1)

Where R = component of red color of the RGB image, G = component of green color of the RGB image, B = component of blue color of the RGB image, r = red color after normalization, g = green color after normalization, b = blue color after normalization. Result from normalization causes the difference of illumination of each pixel which does not depend on the lighting when the image taking for their sum of $r+g+b=I$. 
Figure 3. (a) Image grayscale result of the color normalization to red color on the first test sample, (b) Image grayscale result of the color normalization to green color on the second test sample, (c) Image grayscale result of the color normalization to blue color on the third test sample.

The conversion of gray image into binary image (threshold) is done by determining the certain threshold value in order to obtain an error as small as possible. From this threshold value, it can be determined whether a pixel will be converted into black or white colors.

Threshold process is used to define the object and background information. In the threshold process, a pixel containing information object and having degree of gray value higher than the threshold value specified is then rated as 255 while pixels of the background and has a degree of gray value lower than the threshold value specified is rated as 0. Therefore, object of drug will be colored white and all the background of image will be colored black. The determination of giving value 0 and 255 in the binary image is done by using of the following equation,

\[ g(x, y) = \begin{cases} 
0 & \text{if } f(x, y) < K_{Th} \\ 
255 & \text{if } f(x, y) \geq K_{Th} 
\end{cases} \]

(2)

Where \( g(x,y) \) = binary image results of the threshold process at the point \( (x,y) \). \( F(x,y) \) = the grayscale image was resulted from the colors normalization of at the point \( (x,y) \), \( K_{Th} \) = threshold value. From the threshold test, the data is shown in Table 1.

| Number test sample | Grayscale image result from color normalization | Image result from threshold process | Threshold value obtained |
|--------------------|-----------------------------------------------|-----------------------------------|------------------------|
| I                  | ![Red Grayscale](image)                       | ![Binary Image](image)           | 0.3                    |
| Note :             | Color normalization = red                     |                                   |                        |
| II                 | ![Green Grayscale](image)                    | ![Binary Image](image)           | 0.4                    |
| Note :             | Color normalization = green                   |                                   |                        |
| III                | ![Blue Grayscale](image)                     | ![Binary Image](image)           | 0.4                    |
| Note :             | Color normalization = blue                    |                                   |                        |
From the binary image generated at the stage of threshold process, number of objects can be calculated by using the total of possible outside and inside corners at a pattern of object by using the following equation of 4.

\[
T = \text{abs}\left(\frac{a-b}{4}\right)
\]  

(3)

Where \( T \) = number of objects, \( a \) = number of possible outside corners, \( b \) = the number of possible inside corner. From Equation 4, number of objects from the calculation results by the system (based on the calculation of outside and inside corner) should be rounded so that number of objects produced is not in a fraction.

Table 2. The result of calculation from the first type of sample using digital image processing

| Image Test Sample | Binary Image | Number of Corner | Number of Drug Before Rounding | Number of Drug After Rounding | Note      |
|-------------------|--------------|------------------|-------------------------------|------------------------------|-----------|
|                   |              | Outside          | Inside                        |                              |           |
|                   |              | 51               | 59                           | 2                            | 2         | Packaging fail |
|                   |              | 23               | 27                           | 1                            | 1         | Packaging fail |
|                   |              | 98               | 115                          | 4.25                         | 4         | Packaging pass |
|                   |              | 77               | 89                           | 3                            | 3         | Packaging fail |
|                   |              | 23               | 28                           | 1.25                         | 1         | Packaging fail |
|                   |              | 50               | 58                           | 2                            | 2         | Packaging fail |
|                   |              | 48               | 56                           | 2                            | 2         | Packaging fail |
|                   |              | 52               | 61                           | 2.25                         | 2         | Packaging fail |
|                   |              | 77               | 89                           | 3                            | 3         | Packaging fail |
| Image Test Sample | Binary Image | Number of Corner | Number of Drug | Note         |
|------------------|--------------|------------------|----------------|--------------|
|                  |              | 24               | 28             | 1            |
|                  |              | 1                | 1              | Packaging fail |

From the test results of counting the number objects of drugs using digital image processing on the 10 samples of the first type of drug package, the results indicates that the system can calculate and detect defects drug properly (no failure).

4. Conclusion
Based on test results, it can be concluded that control system for the quality control of drug packaging that has been made can differentiate blister package of drug was defective and without disabilities at a speed of 0.03 m / sec. From the software of image processing using the color normalization method that have been created showing grayscale images on the object drug have degrees of gray is higher than the grayscale image section the background when the drug has the degree of the R, G or B color is higher than the degree of the R, G, B color on the background of packaging. The determination of threshold value indicates that the binary image of the drug is white and a binary image of the background of drug packaging is black.

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