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Local pixel analysis in color constancy to improve feature extraction process

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ABSTRACT: The feature extraction process on a digital image uses a digital image matrix value. Digital image matrix has position information in the index of columns and rows, and the value of the degree of color within a given range of values. The 8-bit digital image has a 256 degrees color rating ranging from the lowest value 0, and the highest value is 255. Based on the combination of position information and the degree of color, more information can developed, such as information on the shape of the object. Gray images have a single dimension color. This paper used the process of feature extraction area used as the basis of information to find the resemblance of the object on two images. Feature will extracted from two digital images to compared, the image converted into gray image to speed up the computation process. The color space changes based on the base color of the RGB color space. A digital camera has an auto white balance feature that can affect the color consistency of an object in a digital image. This may affect the feature extraction process based on the color degree value. This paper proposed a method to get a consistent color configuration. The color difference value is acquire from the analysis of similar feature to the specified size. Color consistency in the image expected to improve accuracy in the process of recognizing objects based on features.

Keywords: Local Pixel, Color Constancy, Feature extraction, Digital Image Processing

1. INTRODUCTION

Image is a representation of the external form of a person or thing in art. Image can be display in digital or print form. Digital images are data stored on a matrix. The dimension of the matrix determines which digital image data can be stored, as in the gray image, a two-dimensional matrix is used, whereas in the color imagery three-dimensional matrices are used. In digital image, the value of row and column matrix is the coordinate value on the two dimensional function while the value on a matrix element is the value of the gray level of the image at the point corresponding to the real image. The matrix element in the digital image also called a pixel, so if there is a digital image with size 2046 x 800 pixels it can be said that the digital image matrix has the size of 2046 rows and 800 columns. in colored images besides having row and column dimensions there is also a third dimension matrix index, so it can be said that in color digital images there are several matrix layers of the same size in which each matrix layer is a representation of an intensity of color [1]. Each layer of matrix that has a gray intensity on each element could be incorporate to produce a color with a certain depth. The matrix layer is a matrix representing red, green, and blue or called RGB. Every element of the matrix has a gray degree value between 0 and 255, so it can be says that every matrix element is capable of storing 256 colors.

Color constancy is a capability that allows recognizing a color even under colored light. The color of an actual object is fixed but due to the reflection of the colored light it is often see to change, this is due to the surface reflection function that causes the color change, as it is influence by the light of origin. Nowadays there is an interest to do research about color constancy on digital image data. The study refers to a process whereby there are objects that have a fixed and unchanging color that is

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affect by changes in lighting when the process of digitizing takes place. Research on color constancy is necessary to support the process of artificial intelligence, especially the process of recognizing the object of a digital image based on complex colors [2]. Although it is generally that humans have a wide range of color constants but based on research on human color constancy that takes into account empirical evidence, the mechanism of color constancy can be divide into two classes namely adaptation mechanisms and simultaneous mechanisms [3]. The mechanism of adaptation is a temporal interaction mechanism because the sensitivity of the visual system especially to the chromatic channel changes in response to the change of light over time. A simultaneous mechanism, defined as the spatial interaction between chromatic channel responses to light, in simple form a simultaneous mechanism relying only on temporal parameters. An example of this mechanism is the simultaneous color contrast [4, 5, 6, 7, 8, and 9] and normalization [10]. There is data indicating that adaptation mechanisms alone or in combination with simultaneous mechanisms can result in large shifts in hue and saturation [4, 5, 6, 7, 8, and 9].

White balancing is one of the stages that affect the process of color change when the process of digitizing takes place. White balancing will adjust a color in the object according to the white composition of the image frame being retrieve. White balance process is often see in some digital optical devices such as digital cameras. White balance process is often execute automatically by the digital camera system when digital image taking takes place. Gray world and Retinex methods are common methods used for white balancing. Gray world and Retinex methods can be combine to find alternative methods [11]. Color constancy process can be used as an image repair process by observing the effect of the light source, by estimating the illumination by calculating the mean of each color space of the image [12]. In digital imagery, the digitalization process is a process performed by a digital optical device that captures the reflection of light from objects. Reflection and lighting are two very important things in image formation, gray-world and gray-edge called white patches can be used to estimate illuminant and reflectance values. Illuminant and reflectance value information is very important to support the process of color correction. Gray-world and white-patch methods have a high probability and work well on high-contrast images [13].

In the process of digital image analysis, some processes need to be done to get the desired information from an image. Digital image data is usually a matrix, so it needs to be more in-depth process to get more information including form recognition, color, or object name. Image data can also use as a basis for finding other imagery that has similar object content. Segmentation process and extraction of digital image features is use to obtain the desired information from a digital image. The Otsu method is one of the segmentation methods that used to separate the image against the background. Two outputs of the Otsu method are process with canny edge detection and color mapping, combined with the thermal threshold value of the thermal image to obtain alternative segmentation methods [14]. Feature extracts are typically use as a preliminary process to obtain information from digital imagery. Information obtained from the feature extraction process used for the introduction or classification of objects in digital images. The introduction or classification of objects is a problem that is raise in the topic of visual computer research. Identification of objects present in a frame based on extracted features. The extracted feature must be unique to distinguish one object from another. Speeded up robust features (SURF) is one of the feature extracts that used in color image data [15]. SURF is one of the feature extraction methods based on the value of the digital image matrix element. Value of the digital image matrix element is a gray degree value of the color space of the corresponding element to produce a color image. Digital images of the same object on different frames can produce different intensity of gray values due to the intensity of light as well as the composition of different additional objects. It happens due to the white balance process that automatically runs when the process of shooting or the process of digitizing takes place. The result of the digital image obtained will produce a different color composition even though there is the same object inside. This can interfere with the feature extraction process and feature matching process because the color intensity recorded on each element of the digital image matrix results in a much different value.

This paper proposed an alternative method of feature extracting process. Feature extraction in this

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study was conduct on two images that have experienced the process of color firmness. Contribution of this research is the process of color firmness based on local pixel analysis. Process of color constancy begins with a feature extraction process on two images, which then performed feature-matching analysis. Pixel area of the two images the corresponding feature then processed to obtain the color difference values of the two images. Image will adjusted by shifting the contrast to get a similar color intensity value. Improving the color intensity of the two images can improve the feature results obtained from the feature extraction process. Result of this research will be tested by using SURF feature extract, which then the results will be validated by matching process features obtained from two images. Results will compared with the extraction process without color adjustment.

2. METHOD

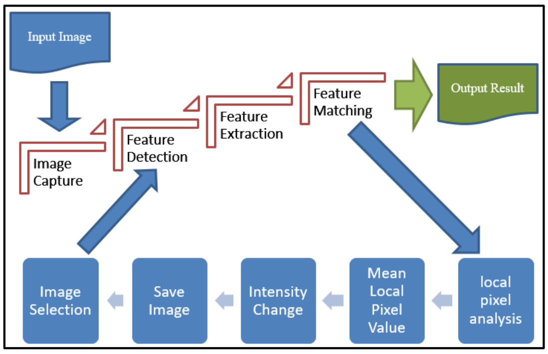

Fig.1 Research Method

Data used in this research is image data taken by using digital camera. Shooting process using auto white balance feature. The object used is a random object contained in a scenario. The analysis will be process on two images taken with different object compositions, but there are several similar objects. Stages of the process in this study seen in Fig 1. The research stages begins with taking pictures using a digital camera. Process is continue by changing the position of the object and the composition of the object, then using the same digital camera and without changing the white balance settings. Both images will then extract its features using SURF. Both features will then be match by using feature matching so the selected features match. Once the feature is match, the feature group data will be re-select by using Random Sample Consensus (RANSAC) or an estimate of the geometric transformation to analyze pixels that change due to geometric transformation. Geometric transformation such as translation and rotation. After obtaining a feature that is considered to be same feature then the selected feature point will be marked as the location area to be analyzed further. The selected area has a predetermined area. Determination of the area of selected area in this study is determined based on image size. This paper used image data with the size of 2448 x 3264 uint8 pixels so that the area used for the selected feature area is 51 x 51 pixels. The area size uses an odd number in order to specify the middle value as the feature point. Pixel analysis is continue by extracting the intensity data from the image matrix element in the specified area, the intensity data is compared to obtain the difference of the intensity value at the corresponding pixel. Average value of each feature point then used as a basis for changing the intensity value of the initial image

The intensity changes image will saved into a new image. The new image consists of two kinds, for the image that has the difference below the mean value then the intensity value on each element of the image will added with the mean value. While the image has the difference above the mean value, the intensity value on each element of the image will subtracted by the mean value. Mean values of each element of the feature area are obtained using the following formula.

$$MeanGrey = \frac{1}{(n*m)} \sum_{i=1}^{n} \sum_{j=1}^{m} (A_{i,j} - B_{i,j}) \quad (1)$$

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Where $MeanGrey$ is the average value of the difference in intensity of the two corresponding feature. $A_{i,j}$ and $B_{i,j}$ is every element in image A and image B. New image of the result of the intensity change calculated using the following formula.

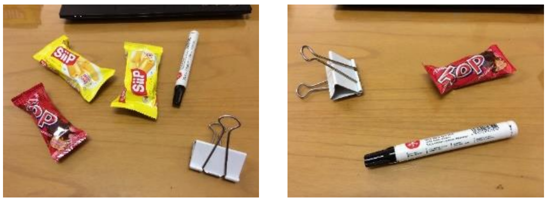
$$sValue_{i,j} = A_{i,j} - MeanGrey \qquad (2)$$
$$qValue_{i,j} = B_{i,j} + MeanGrey \qquad (3)$$

Where $sValue$is a new image obtained from changes in the intensity value of the first image, while $sValue$ is a new image obtained from the change in the intensity value of the second image. Next to the test process is do with the same stages as when performing detection and feature extraction, but the image data used is new image data. The test results will use cross data i.e. image A compared with $qValue$, then $sValue$ compared with image B, and $sValue$ compared with $qValue$

3. RESULT AND DISCUSSION

The data used as test data is the image obtained by using a digital camera. The image taken from a scenario by arranging objects on a table. It consists of snacks, markers, and clips as shown in Fig. 2a and 2b. Seen from Fig. 2a and 2b there is a difference in the composition of the object. Differences in the composition of the object performed to test the feature detection process, feature extraction, and feature matching process. From the two pictures in Fig. 2 there are several objects that are the same, but because the composition of the object is different, then two images show the difference in light intensity reflected by the object. From the picture shows that there are differences in intensity, especially on the object table which is the background object of the image. The table color in Fig. 2b is brighter than the table color in Fig. 2a. The difference in the value of the intensity of the local pixel will used to change the color in order to obtain a constant color of the two images.

In accordance with the method proposed in this study, the first step is to perform feature detection process in both imagery using SURF method. The features that have been obtained then extraction process followed by the feature matching process to obtain the corresponding feature data between the first image with the second image. The result of feature matching is then marked as in Fig. 3.



(a) (b)

Fig.2. (a) First Scene, (b) Second Scene

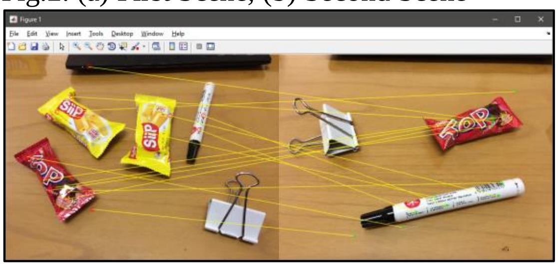


Fig.3. Mark Result of Feature Matching

The next process is a process to estimate the geometric transformation using the RANSAC method to obtain a valid feature. As shown in Fig. 3 there are still some features that considered good even though they are not compatible. The results of the geometric transformation estimation process shown in Fig. 4. It seen in Fig. 4 that there are three selected features right on the same two objects

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in different imagery. Selected features are then performed pixel analysis around the feature point of 51 x 51 pixels. Feature point then calculated the average difference in intensity of the area that has been determined. The next intensity difference used to change the intensity of the image to be lighter or darker according to the formula described in the method sub-chapter.

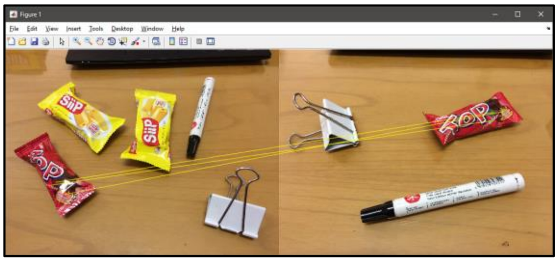

Fig.4. Result of Feature Matching After Estimate Geometric Transform

An image that has been process in intensity will have a different color from the original image. The color difference that occurs due to changes in the intensity value of each element of the matrix in each color space. The change in intensity value seen from the histogram changes from the original image compared to the image of the result. Histogram change as shown in Fig. 5 shows that the image changes to be brighter.

The next process is to perform feature detection, feature extraction, and perform feature matching using the new image data. Two new image data will used as input images by cross-comparison according to the test scenario described in the method sub-chapter. The results of the test scenarios will displayed in table form with the variable number of features as well as the number of feature matches. The number of feature matches in this research was used as a measure of the success of the proposed method. The results of the test process as shown in Fig. 6, 7, and 8, that there is a change in the number of features detected as features that have a match. In Fig. 6, we used the first image data with the second new image data, while in Fig. 7 we used the first image data with the second image data. In Fig. 8, we use new data for the first and second images.

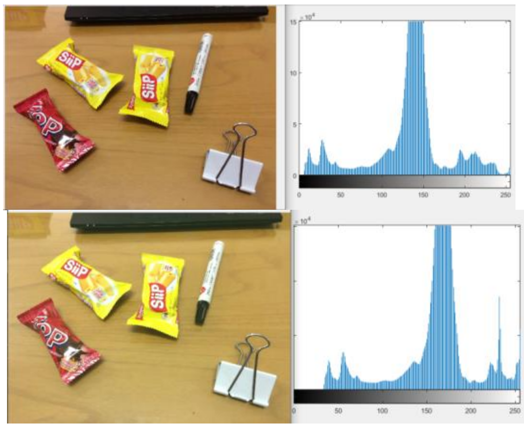

Fig.5. Result of Intensity Change

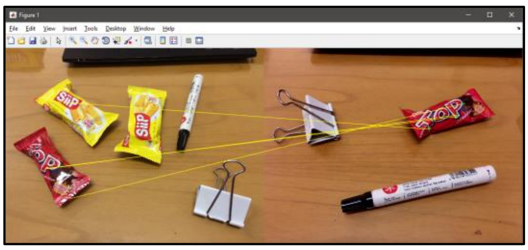

Fig.6. Result of Intensity Change

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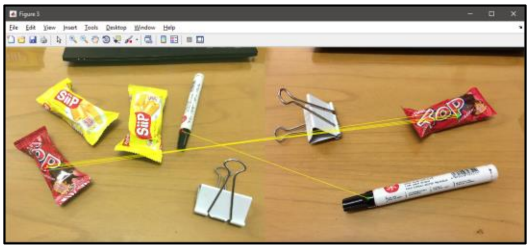

Fig.7. Result of Intensity Change

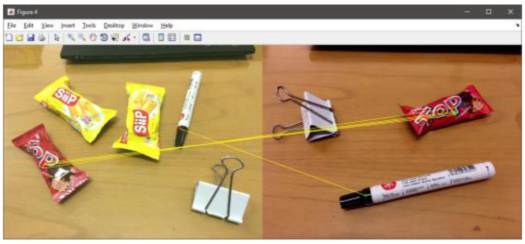

Fig.8. Result of Intensity Change

4. CONCLUSION

The proposed method has influenced the outcome of the feature detection process, feature extraction, and feature matching process. Seen from the test results performed, there are differences in the results of feature matching. The proposed method looks able to increase the number of features successfully matched. From the test results, it can concluded that the proposed method has been successful, with some shortcomings. The shortcomings of which are visible from some objects still not detected as the same object.

5. ACKNOWLEDGEMENTS

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