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OBJECT REMOVAL USING EXEMPLAR-BASED INPAINTING

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ABSTRACT

Technological development is so rapid, followed by the ease of taking pictures. The problem is the hole caused by undesired object being erased. To overcome the problem, filling the hole region within the image by using the novel based exemplar method. The main advantage of using this method is the usage of order filling that is dependent on the value of the isophote and the number of source region. The result shows that the size or the shape of the object selection, gradation, diffusion of color, and blur significantly affects the result of the in painting. Priority plays a significant role in picking the color in the source region. Clear gradient not affected by light diffusion, color gradation, or blur will make a "natural" in painting result.

Keywords: Avalanche Cross Isophote, Edge Detection, In painting, Novel based, Exemplar based.

INTRODUCTION

Nowadays, storage in digital form is increasingly being used because it is more accessible, easily to transferred, manipulated, and others. Excessive use of paper which can damage the Earth's atmosphere, caused by the paper is the result of wood, bamboo, other plant fibers. Saving paper on digital storage can be obtained by fixing the digital storage before the storage is printed.

Digital storage is applied by many people to store an image. Image storage is needed because many mobile phone that is equipped with a digital camera to help capture digital images at any time. Besides being used in mobile communication media cameras, the digital images are also widely used in other electronic media such as laptops, computers, tablets, and others.

Digital storage technologies now supported with image processing technologies that make it state of the art of digital image storage. Image processing technologies that helps in resizing the image, manipulating brightness and contrast effects on the image, change the color to black and white, and many more. Image processing is very helpful in getting the desired image

Taking pictures with a digital camera is increasingly being used in the presence of cameras on mobile devices and other electronic devices. Many images being manipulated in terms of lighting and image objects in such a way to get the results desired image. There are a way to manipulate the pictures to remove unwanted objects so smoothly even user did not know what object that has been removed.

IN PAINTING

In painting is an image processing to cope with an unwanted objects. Inpainting algorithm is a basic technique that is used by professionals painting restorator. These algorithm is quite conventional. There are many algorithms that have been developed to improve in painting, which are exemplar-based in painting, the fast marching method, linear structure and many others.

These methods do a search of the source area to determine the areas most similar to the area to be filled. Search on an area-pixel information required a good information about surrounding area. The search is assisted by a sliding window size has varied, starting with a sliding window which has a size of 3x3, 5x5, 7x7 and 9x9. As more information about the area more good effect on the search.

An Algorithm that used the order of filing as filling process is exemplar-based in painting. The information of surrounded area greatly affect this algorithm, in other words that the most importance section from this algorithm is source searching with best accuracy. equation that used in the search process can be viewed as follows:

$$P(x,y) = C(x,y) * D(x,y) \qquad (1)$$

x and y in the search priority equation is the coordinate from a pixel that will be filled at those coordinates. Of all the required more information from sources area and the sliding window. Sliding window used in the exemplar-based in painting is 9x9 (freeman, 2001), (Hussain, 2011), (Francois, 2010)

C Function in the priority search equation is the area source intensity at the 9x9 window compare to the target region. While the D function is the equation to find the value of the information contained on that coordinates. The information can be represented by a value that has a straight comparison with an edge detection. Influence areas that have relationships with other have priorities to be filled first. However, the intensity factors and information sources have a balanced comparison (freeman, 2001)

$$\phi = I - \Omega \qquad (2)$$

Ω is a symbol of the area to be searched or the area that has been removed or the area that has been selected, the first is the overall picture. While ϕ is the area where the source of information that is lost will be obtained from sources area.

In Figure 1, there is a variable that has not been defined. Variable $\delta\Omega$ is a variable contour where the red line as a marker of contour or border between the source region with the area searched or removed.

After contour, area removed, and areas that are not removed are known. Calculation priority at any point contained in the contour will be done as in the following equation:

$$P(\varphi) = C(\varphi) * D(\varphi) \qquad (3)$$

Fig 1: Source Area and Search Area

p is a point contained in the contour. This calculation requires a 9x9 window as an aid to get information about. The above equation can be further elaborated as follows:

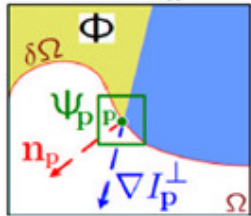$$D(p) = \frac{\nabla U p^\perp . n_p}{\alpha}$$

Fig 2: Variable initiation

D function is a function to measure the value of isophote contour area to be removed. Isophote calculation performed on each iteration. Each isophote perform the calculations necessary update recalculated due to a change in the information in the sliding window, where about suffered the effects isophote contour and function of C as well. (Francois, 2010), (Qiuqi,2006). The function D is also influenced Np, as a normal point which has a direction to the area that has been removed. While the C function look at the intensity of the source. The more the value of the source area the greater the value of C at that point. Resource values seen by the sliding window across each contour point. (Freeman, 2001), (Hussain, 2011), (Qiuqi, 2010).

Contour has several functions that will be used in the calculation of priority, source searching rounding by sliding window. Source searching process using MSE calculations (Mean Square Error) as the following equation:

$$\sum \frac{(Wp - Wq)^2}{n} \qquad (4)$$

Wp is a sliding window with size 9x9 is located at coordinates contour. Where Wp is the part that needs the information. While Wq is the part that has a similar resemblance to Wp. (Stephen, 2012)

SYSTEM DESIGN

There are several processes involved to make this application. Among them is the selection of unwanted objects, manufacture contour, calculating the value of

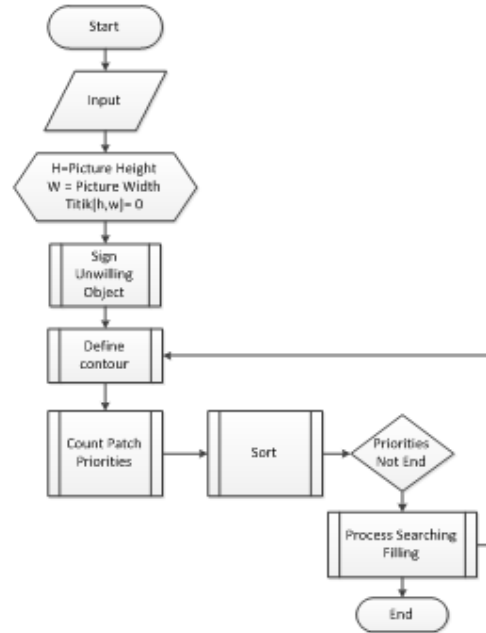priority and resources as a search in the area most similar to patch the patch that is being sought.

Fig 3: System Flowchart

The first process is the selection will be carried out unwanted objects. Selection on unwanted objects is removing unwanted objects selection process followed by the making of contour objects. However, the manufacturing contour process is always done continuous when the target region turned into a source region. The process can be seen in Figure 4
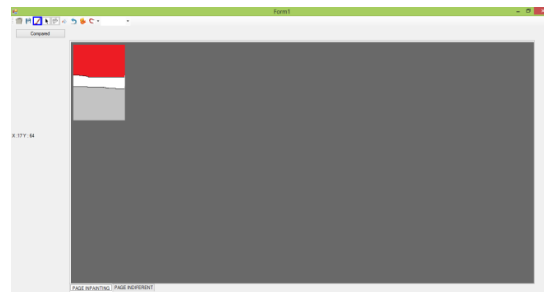

Fig 4: Building Contour and object selection

In Figure 5 shows that as long as there is still a target region then contours will be made on an ongoing basis. In accordance with the meaning of the contour is the boundary between the source region to region removed. To find a local source obtained the following equation:

1.   Contour Identification.
2.   Priority calculation.
3.   Find highest Priority
4.   Search source area that are closest
5.   Update Cp and Dp
6.   Renew Contour
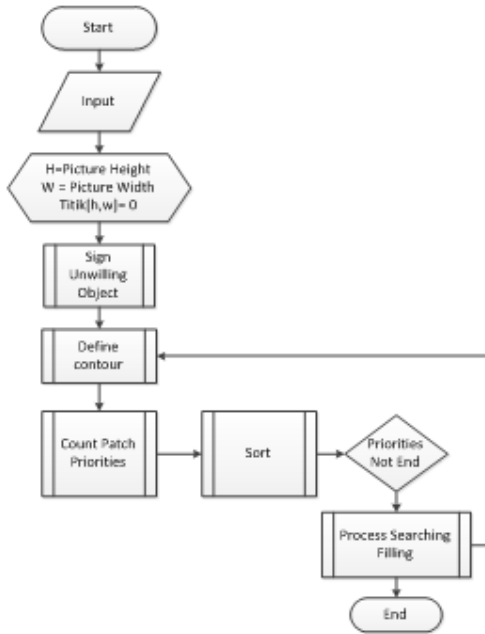7.   Repeat step 1-4 until there are no Contour

Fig 5: Source searching flowchart

SYSTEM TESTING

Experiments on exemplar-based in painting viewed by 4 things, among others:

1. Tests against masking with a different size or shape in the same image.
2. Tests against masking on the image to go to the edge of the image.
3. Tests against masking the source region around it has the effect of color gradation, image sharpness or blur less powerful, refracting colors.
4. Tests granting masking the source region around it have no effect of color gradation, image sharpness or blur less powerful, refracting colors.

1. Tests against masking with a different size or shape in the same image.

Table 2: Testing with different masking

Source			
N o	Masking	Detail	Result
a		Masking 10.59% Error 1733 Time 11:37	
b		Masking 12.53% Error 2069 Time 12:53	
c		Masking 13.36% Error 2519 Time 13:44	

The shape and size of the masking influence the outcome of inpainting. The intersection of the edge causing the effect occur.

2. Tests against masking on the image to go to the edge of the image.

Table 3: Masking Edge Towards testing

Source			
No	Masking	Detail	Result
a		Masking 16.37% Error 0 Time 0:10	
b		Masking 9.87% Error 0 Time 0:05	
c		Masking 13.58% Error 0 Time 0:08	
d		Masking 17.87% Error 1621	

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		Time	0:23	
e		*Masking*	13.59%	
		Error	0	
		Time	0:07	
f		*Masking*	56.7%	
		Error	0	
		Time	00:30	

b		*Masking*	14.53%	
		Error	707.55	
		Time	15:32	
c		*Masking*	12.38%	
		Error	763.14	
		Time	12:29	

Error values in Table 5 are not directly proportional to the large masking. Segment masking influence in getting the value error. Segment in Figure b is a segment that is contained on the grass masking. So get the smallest value in the large masking 14:53% by comparison with the large masking error.

Giving up towards the edge masking in Table 3 shows that all the contours have the same priority value. So that all contours have the same rights in charging each iteration.

3. Tests against masking the source region around it has the effect of color gradation, image sharpness or blur less powerful, refracting colors.

Table 4: Testing the influence Pictures

Source				
No	**Masking**	**Detail**		**Result**
a		*Masking*	28.81%	
		Error	544.32	
		Time	09:38	
b		*Masking*	10.13%	
		Error	249.6	
		Time	01:24	
c		*Masking*	3.38%	
		Error	17.09	
		Time	01:24	

Error values in Table 4 show that the test error value depends on the input masking segment. The more segments the image masking effect to generate an error value is increasingly getting more and more large.

4. Testing Source Masking Region that Has No Effect

Table 5: Source Masking Region that Has No Effect

Source				
No	**Masking**	**Detail**		**Result**
a		*Masking*	11.77%	
		Error	1593	
		Time	10:20	

5. Testing Against Masking Size

Table 5 : Masking Size testing

Source			
Masking			
Size Of Picture			300x199
Size Of Masking			7.78%
No	**Detail**		**Result**
a	*Error*	113.44	
	Time	02:16	
	Big Of Patch	9x9	
b	*Error*	113.44	
	Time	02:09	
	Big Of Patch	7x7	
c	*Error*	154.68	
	Time	02:09	
	Big Of Patch	5x5	
d	*Error*	165.83	
	Time	00:04	
	Big Of Patch	3x3	

Size has a masking effect on the value of the closest similarity. The closer a point in common with the search point will affect the search time.

CONCLUSION

Based on the testing that has been done , we can conclude some of the following :
• The effects of blur , glow , and the gradations of light refraction greatly affect the priority . Parts of lighting effects always get high priority . So that part should have a

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higher priority will most likely disappear .

• Value error is affected by masking a large , blur effect , light , refraction and color gradation .

• The smaller the masking then make the resulting error value is smaller . However, the error value is also influenced by the image search .

• error value is also influenced by the administration of masking . Giving masking that has more than one segment has more error , because the search on many segments strongly influenced by the priorities , the effect of image color and image quality .

• Search on the image quality is affected by the resolution of the image . The larger the image resolution the clearer the image search , because the greater the number of pixels image resolution the more detail that makes the pixels more than the number of pixels smaller .

• the smaller size makes the search more details on the search for patches more clearly .

• Time inpainting process influenced by masking a large , large images , the size of the patch and the search for the nearest patch . The closer the search found the faster processing time is done .

• Picture quality has a greater value smaller error , error value compared to the big picture . However, administration of masking the affect on the outcome of the segment error value . Provision of masking at the same object with different size or shape affect the results of inpainting

• Form masking that has a cavity at the center greatly affect the results because the central part of the information is not too full .

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