Bone Crevice Revelation Proving with Open CV

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Abstract— Image processing is any form of signal processing for which the input is an image, such as a photograph or video frame the output of image processing may be either an image or a set of characteristics or parameters related to the image. Edge detection is a basic and important subject in computer vision and image processing. The purpose of this Paper is to find out the accuration of an X-Ray Bone Fracture Detection using Canny Edge Detection Method. A bone fracture is a medical condition in which there is a break in the continuity of the bone. A bone fracture can be the result of high force impact or stress, or a minimal trauma injury as a result of certain medical conditions that weaken the bones, such asosteoporosis, bone cancer, or osteogenesis imperfecta, where the fracture is then properly termed a pathologic fracture. This paper proposes OpenCV library combined with Canny Edge Detection method to detect the bone fracture. The Canny edge detector is an edge detection operator that uses a multi-stage algorithm to detect a wide range of edges in images. The Simulation results are shown how canny edge detection can help to determine the location of fractures in X-ray images.

Key words: Fracture, Edge, Edge Detection, Canny, Threshold, X-Ray Images

I. INTRODUCTION

Pictures are the most common and convenient means of conveying or transmitting information. A picture is worth a thousand words. Pictures concisely convey information about positions, sizes and inter-relationships between objects. The field of digital image processing refers to processing digital images by means of a digital computer. Note that a digital image is composed of a finite number of elements, each of which has a particular location and value. These elements are referred to as picture elements, image elements, and pixels. Pixel is the term most widely used to denote the elements of a digital image. Vision is the most advanced of our senses, so it is not surprising that images play the single most important role in human perception. However, unlike humans, who are limited to the visual band of the electromagnetic (EM) spectrum, imaging machines cover almost the entire EM spectrum, ranging from gamma to radio waves. They can operate on images generated by sources that humans are not accustomed to associating with images. These include ultra-sound, electron microscopy, and computer-generated images. Thus, digital image processing encompasses a wide and varied field of applications.

Medical imaging refers to several different technologies that are used to view the human body in order to diagnose, monitor, or treat medical conditions. Each type of technology gives different information about the area of the body being studied or treated, related to possible disease, injury, or the effectiveness of medical treatment. Medical imaging seeks to reveal internal structures hidden by the skin and bones, as well as to diagnose and treat disease. Medical imaging also establishes a database of normal anatomy and physiology to make it possible to identify abnormalities. Medical Imaging is part of biological imaging and incorporates radiology which uses the imaging technologies of X-ray, radiography, magenetic resonance imaging, medical ultrasonography or ultrasound, endoscopy, elastography, tactile imaging, thermography, medical photography and nuclear medicine functional imaging techniques as positron emission tomography.

The Canny edge detector is an edge detection operator that uses a multi-stage algorithm to detect a wide range of edges in images. Canny uses the calculus of variations – a technique which finds the function which optimizes a given functional. The optimal function in Canny's detector is described by the sum of four exponential terms, but it can be approximated by the first derivative of a Gaussian. This image processing system use OpenCV library and Canny Edge Detection Method that expected to minimize error on detecting bone fracture.

II. RELATED WORK

Image processing techniques are employed to develop this algorithm. It is discussed in detail in this section.

A. Canny Edge:

Edge detection is the name for a set of mathematical methods which aim at identifying points in a digital image at which the image brightness changes sharply or, more formally, has discontinuities. The points at which image brightness changes sharply are typically organized into a set of curved line segments termed edges. The same problem of finding discontinuities in 1D signals is known as step detection and the problem of finding signal discontinuities over time is known as change detection. Edge detection is a fundamental tool in image processing, machine vision and computer vision, particularly in the areas of feature detection and feature extraction. The Canny Edge Detection is performed on the frames with the sensitive threshold values (upper threshold 10000 and lower threshold 4900) and again it is performed with the insensitive threshold values (Upper threshold 50000 and lower threshold 9800). If a pixel has a gradient greater than the upper threshold, then it is an edge pixel. If a pixel has a gradient lower than the lower threshold, it is not an edge pixel. If the pixel's gradient is between the upper and lower thresholds, then it is considered as an edge, only if it is connected to a pixel that is above the high threshold values as given in[5,11].

The Process of Canny edge detection algorithm can be broken down to 5 different steps:

1) Apply Gaussian filter to smooth the image in order to remove the noise
2) Find the intensity gradients of the image

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3) Apply non-maximum suppression to get rid of spurious response to edge detection
4) Apply double threshold to determine potential edges
5) Track edge by hysteresis: Finalize the detection of edges by suppressing all the other edges that are weak and not connected to strong edges.

Canny is one of modern edge detection method that founded by Marrdan Hildreth, who is doing research in modeling human visual perception. There are several criteria on edge detecting that can be fulfilled by Canny Edge Detection:

1) Canny has better detection (for detection criteria). Canny method capable to marks all existing edges matching with user determined parameter's threshold. Also giving high flexibility on determining thickness level of edge detection according to the required conditions.
2) Canny has better localizing way (localize criteria). Canny capable of producing minimum gap between detected edge and the real image edge.
3) Obvious response (response criteria). Only one response for every edge. This makes less confusion on edge detection for the next image.

Choosing parameters on Canny Edge Detection will giving effect on every result and edge detection. The parameters are:

1) Gaussian Deviation Standard Value.
2) Threshold Value.

The following is the steps to do Canny Edge Detection.

1) Remove all noise on the image by implementing Gaussian Filter. The result is an image with less blur. It is intended to obtain the real edges of the image. If we did not apply the Gaussian Filter before, sometimes the noise itself will be detected as an edge.
2) Detect the edge with one of these detection operators, like Roberts, Perwit, or Sobel by do horizontal searching (Gx) and vertical searching (Gy). The following is the sample of edge detection operator (Sobel operators).

-1	0	+1
-2	0	+2
-1	0	+1

(a)

+1	+2	+1
0	0	0
-1	-1	-1

(b)

Fig. 1: Sobel Operator (a) Gx, (b) Gy

The result from both operators combined to obtain the summary of vertical edge and horizontal edge with this formula [6]:

$$[G] = [Gx] + [Gy] \qquad (3)$$

3) Determining direction of the edge by using the following formula:

$$G = \sqrt{G^2x + G^2y} \qquad (4)$$

$$\theta = \arctan\left(\frac{Gy}{Gx}\right) \qquad (5)$$

Canny Edge Detection using two thresholds (maximum threshold and minimum threshold). If pixel gradient higher than maximum threshold, pixel will be marked as an edge. If the pixel gradient lower than minimum threshold, the pixel will be denied as background image. If the pixel gradient between maximum threshold and minimum threshold, the pixel will be accepted as an edge if it is connected with other edge pixel that higher than maximum threshold.[11]

4) Minimize the emerging edge line by applying non maximum suppression. This process will give slimmer edge line.
5) The last step is binarizing the image pixels by applying two threshold values.

III. SYSTEM OVERVIEW

System overview of this program is discussed in detail in this section. The next figure shows the system design in flowchart. This flowchart explains the process flows from detecting X-ray image until producing the bone fracture detection on the X-ray image.

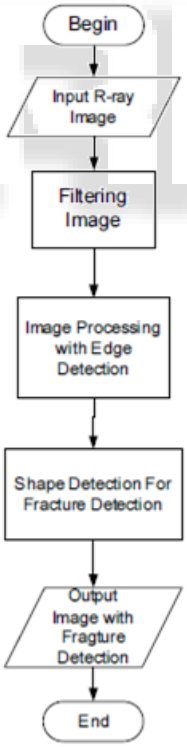

Fig. 2: Flowchart System

Here is an explanation of the performance of the system:

1) First user must input an image to be processed; the image will then be carried filtering to remove noise that exists in the image.
2) The next step will performed after image filtering process, the image will be processed using Canny

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Edge method, it will give results more visible lines on an X-ray image.

3) The system then combines the results of early detection canny with the original image, then user can clearly see the shape of the bone and these combined images will be processed by the system.
4) To detect the location of the fracture in the image, the system use shape detection with multiple parameters. A broken bone is expressed when the line has an end, and do not have a connection with another line. A broken bone stated, if the lines form an angle less than 145 degrees, although the line still has a connection with the other lines.
5) The parameters on system specify in determining the location of the broken bone is as follows:

– The red color, indicating the location after the end of a line through process canny edge detection. Where the line is only a single line and doesn't have adjacent to any other lines.
– The blue color indicates the location of the end of a line next to each other (this is intended to indicate the location of the line that has the possibility of having a hairline fractured bone).
– The green color indicates the location of the end of a line in the line has a lot of ends. The amount of a tip in the first line helps the system to recognize the location of a major fracture in the picture.

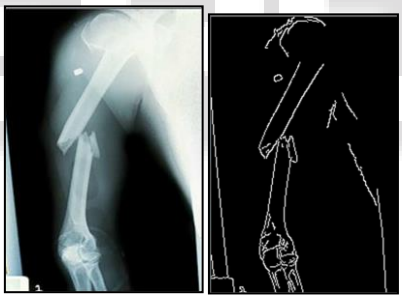
This system builds from OpenCv library, CV namespace contains image processing and camera calibration methods. The computational geometry functions are also located here. CVAUX namespace is described in OpenCv's documentation as containing obsolete and experimental code. However, the simplest interfaces for face recognition are in this module. The code behind them is specialized for face recognition, and they're widely used for that purpose. ML namespace contains machine-learning interfaces. High GUI namespace contains the basic I/O interfaces and multi-platform windowing capabilities. CVCAM namespace contains interfaces for video access through DirectX on 32-bit Windows platforms.[7,8]. In book of [13,14,15] there much information about using OpenCv for build this system. Here is an example pseudo code from OpenCv that determining the location of the broken bone.

```
//Setting the parameter for edge detection
result = cvApproxPoly(contours, sizeof(CvContour), storage,
CV_POLY_APPROX_DP,
cvContourPerimeter(contours)*0.05, 0);
//Red Point detection indicating for edge detection
if(result->total==2 )
{
CvPoint *pt[2];
for(int i=0;i<3;i++){
pt[i] = (CvPoint*)cvGetSeqElem(result, i);
}
// blue point detection, indicating for hairline fracture bone
if(result->total==3 )
{
CvPoint *pt[3];
for(int i=0;i<3;i++){
pt[i] = (CvPoint*)cvGetSeqElem(result, i);
}
//Green Point detection, indicating for major fracture
else if(result->total==4 )
{
CvPoint *pt[4];
for(int i=0;i<4;i++){
pt[i] = (CvPoint*)cvGetSeqElem(result, i);}
```

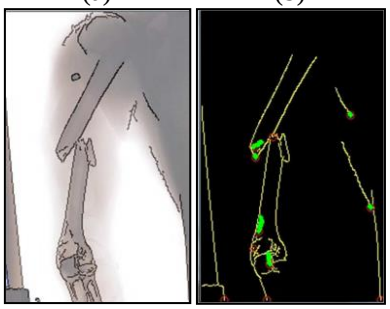
IV. RESULT

Figure 3 shows step 1 – 5 in Section 2 to start the bone fracture detection process. The first image output has been processed through Canny Edge Detection method, and then followed by the shape detection. Shape detection used to find the end of a line. End of a line can be ascertained as the position where the fracture occurred. This application can reduce the unused parameter that categorized as undamaged part (Section 2).

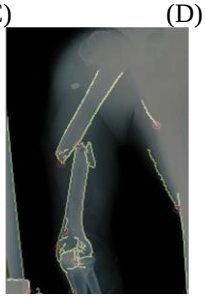
There are many outputs from these proses, which are the original image to be processed, 2 images that has been processed by Canny Edge Detection method, and 2 images that shows the user the result of fracture detection. Figure 3 will show those 5 outputs. In figure 3 the user uploads an x-ray image, figure 3(a). Then system will process that image with Canny Edge detection, figure 3(b). In figure 3(c) system shows the output of image processing, by combining the image of canny edge detection result and inverting the original image that uploaded by the user. In figure 3(d) system will detect the location of the end of each line. In Figure 3(e) the system will then automatically detect fractured bone and its location.



(a) (b)



(C) (D)



(E)

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Fig. 3: (a) Input Image (b) Output Image with canny Detection(c) Invert Output Image Canny Detection (d) Output image with canny Detection with edge detection in every edge (e) Output image with Fracture detection.

To clarify the performance of the system, we decided to process the other images. Here is an example of the results of the image processing:

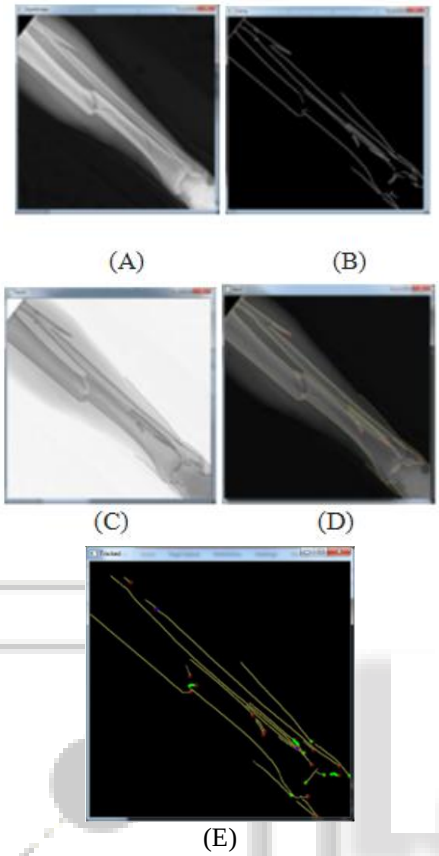

Fig. 4: (a) Input Image (b) Output Image with canny Detection(c) Invert Output Image Canny Detection (d) Output image with canny Detection with edge detection in every edge (e) Output image with Fracture detection

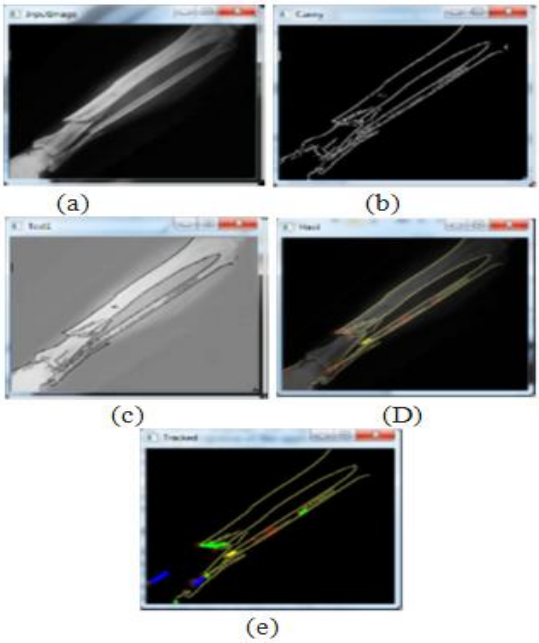

Fig. 5: (a) Input Image (b) Output Image with canny Detection(c) Invert Output Image Canny Detection (d) Output image with canny Detection with edge detection in every edge (e) Output image with Fracture detection

After a number of attempts to detect the location of the fracture, the results of the experiments are summarized in Table 1.

No	End Of Line Detection (Red)	Hairline Fracture Detection (Blue)	Fracture Detection (Green)
1	11 Edge Detection	None Hairline Fracture Detection	6 Major Fracture Detection
2	22 Edge Detection	1 Hairline Fracture Detection	9 Major Fracture Detection
3	15 Edge Detection	2 Hairline Fracture Detection	3 Major Fracture Detection

Table 1: Result of Fracture Detection

Table 1 shows the number of results of the detection system bone fracture, and accuracy of system detection can be seen in Table 2.

No	Hairline Fracture (a)		Major Detection (b)		Accuracy	
	True	False	True	False	A	b
1	-	-	4	2	-	50%
2	1	-	5	4	100%	55,6%
3	1	1	2	1	50%	66,7%

Table 2: Accuracy of Fracture Detection

V. CONCLUSION

This Paper presented the Canny Edge detection framework to assist radiologist in detecting fractured bones from x-ray images. It has been tested with real data. Simulation result shows that the system need to be improvised on it performance and reduce the response time.

According to the test result that has been done to detect the bone fracture, a conclusion can be made that the performance and accuration of the detection method affected by the quality of the image. The better the image quality, the better result system got.

For the future development, there are some things that must be noted:

1) Implement another image processing method in order to improve the accuration of image detection.
2) Adding various language will capable on supporting the integration of this application to other application or system.
3) Improvise the method performance to decrease the amount of time and decrease the percentage of error by adding several model of different neural networks trained with different architecture before initiating this system.

REFERENCES

[1] Mubeena Pathan, K.Jusoff, M. S. Alias ”Implication Of Image Processing Algorithm In Remote Sensing and gis applications”, Journal of Theoretical and Applied Information Technology, 15th December 2011, vol 34 No 1.

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[2] Fazal-E-Malik ”Mean And Standard Deviation Features Of Color Histogramusing Laplacian Filter For Content-Based Image Retrieval”, Journal of Theoretical and Applied Information Technology, 15th December 2011, vol 34 No 1.
[3] Mostafa Syiam, “AdAgen : Adaptive Interface Agent For X-Ray Fracture Detection”, International Journal of Computing & Information Sciences, December 2004, vol 2, no 3.
[4] Dhanabal R,” Digital Image Processing Using Sobel Edge Detection Algorithm In Fpga “, Journal of Theoretical and Applied Information Technology, 10th December 2013, Vol. 58 No.1.
[5] Rafael C. Gonzalez, Richard and E. Woods, “Digital Image Processing”, Third Edition, 2009.
[6] Batra Yudha Pratama,”Pendeteksian Tepi Pengolahan Citra Digital “, 2007, Komunitas eLearning IlmuKomputer.Com.
[7] Robin Hewitt, 2010, Available at :http://www.cognotics.com/opencv/servo_2007 _series/part_1/index.html 2010/09/02.
[8] Shervin Emami,”Facial Recognition using OpenCV”, Journal of Mobile, Embedded and Distributed Systems, vol. IV, no. 1, 2012.
[9] Bin Yu and Anil K. Jain, “Lane Boundary Detection Using A Multiresolution Hough Transform,” Dept. of Computer Science Michigan State University, East Lansing, MI 48824, IEEE Conference, October 1997, vol. 2, pp. 748-751.
[10] N. Otsu, “A threshold selection method from grey-level histograms”, IEEE Trans. Syst., Man, Cybern, Vol. SMC-8, 1978, pp. 62–66.
[11] Darma Putra,“Pengolahan Citra Digital”. Andi. Yogjakarta, Indonesia, 2010.
[12] Xuan Mo, “OpenCV Tutorial I: Image Processing”, iPal Grub Meeting , 2011.
[13] David Stavens,” The OpenCV Library: Computing Optical Flow”, Stanford Artificial Intelligence Lab, 2013.
[14] Robert Laganière,” OpenCV 2 Computer Vision Application Programming Cookbook”. Packet Publishing , 2011.
[15] Klaus D. Toennies, “Advances in Computer Vision and Pattern Recognition”. Springer-Verlag, London, 2012.
[16] Alan Ezust, Paul Ezust, “An Introduction to Design Patterns in C++ with Qt 4”.Pearson Education, 2007.

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