Journal of Telematics and Informatics (JTI)
Vol.6, No.2, June 2018, pp. 102~109
ISSN: 2303-3703

Analysis of Bone Fracture Detection Based on Harris Corner Detector Method

Bahrun Niam[1], Imam Much Ibnu Subroto[2], Sri Arttini Dwi Prasetyowati[1]
[1]Department of Electrical Engineering, Faculty of Industrial Technology, Universitas Islam Sultan Agung, Semarang, Indonesia
[1]Department of Informatics, Universitas Islam Sultan Agung, Semarang, Indonesia

Abstract

Bone is part of the human body to sustain other parts of the body. One of the bones is leg bone. Leg bones have often cracks or fractures caused by collision. Leg bone fractures can be identified by using x-ray manually. Eye train can cause less accurate in identifying the result of roentgen so that it needs a method to make radiologist easier in determining leg bone fractures. The recommended method in this research was Harris corner detector method. Before identified, the object was firstly in pre-processing such collecting data, grayscale and cropping image. The research result was Harris corner detector method could identify leg bone fractures with 70% accuracy.

Keywords : Bone, Grayscale, Harris Corner Detection.

1. Introduction

Currently, technology and sciences have very rapidly development. The development of medical science is also needed to find out the result and improve speed and accuracy of medical treatment especially in identifying a certain illness. One of the applications in processing image is detecting bone fractures in shinbone. To analyze the bone fractures, medical team commonly uses roentgen resulted from x-ray. Sometimes, the roentgen has bad result in quality and less accurate observation. Therefore, it needs application to detect bone fractures.

2. Theoretical Review

2.1 Shinbone and Fibula

Lower limbs have two bones; shinbone and fibula. Shinbone is the main skeleton of lower limbs and located in medial of fibula. The shinbone is bone pipe with a rod and two ends. The top has medial condyle and lateral condyle. These condyles are the uppermost and most marginal part of the bone. The superior surface shows that two plane surface joints for the femur in knee joint formation. [1].

Fibula is bone of the lower limb located on the lateral and its form is smaller based on the structure of the forearm bones. The meaning of fibula is thin or small. The bone is long, has variation in the corpus because of vary form of the strength of the muscles attached to the bones. The bone is not order in forming ankle joints. The bone is not bone keeping weight. [1]

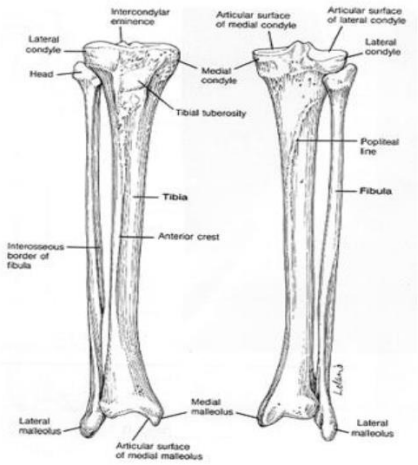


Figure 1. Bones of the Lower Limb

2.2 Digital Image

Generally, the procedures of digital image shows that the processing of figure 2 using computer. In the larger context, the processing of digital image refers to the data processing of 2 dimensions. Digital image is array consisting of both the real and complex values which are represented by a certain row of bits. [2]

An image is defined as a function f(x,y) having a measurement of M row and N column, with x and y are spatial coordinate and amplitude f on the coordinate point (x,y) called by intensity or the gray level of the image on a certain point. If the value of x,y and the value of amplitude f are finite and discrete, it can be said that the image is digital image. Figure 2 shows menunjukan posisi koordinat citra digital. [2]

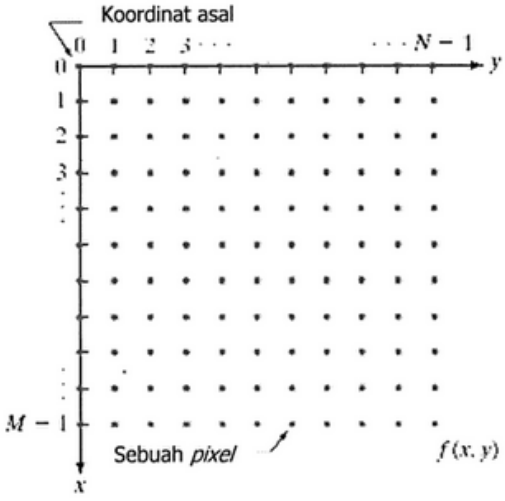


Figure 2. Coordinate of Digital Image

2.3 Grayscale

Grayscale is the discoloration into gray images. Grayscale is digital image that just have 1 channel value on each pixel. On the other hand, the value of Red = Green = Blue. The value is used to show the level of intensity. Grayscale image is formed from 8 bit per pixel and uses 256 shades of gray as the base of the color. On the grayscale process, each RGB pixel of the image is taken by the value and calculated the mean of RGB. Then, each value of RGB is initialized by their mean so that the result is gray color of image matrix that has been conducted the grayscale process. [3]

2.4 Harris Corner Detector

Harris corer is a detection algorithm considering the local gradient in the horizontal and vertical directions of each point around it. The aim is to find out the value of the image having different intensity on both directions. [4]

$$R_H = \det(M) - k * trace^2(M) \quad (1)$$

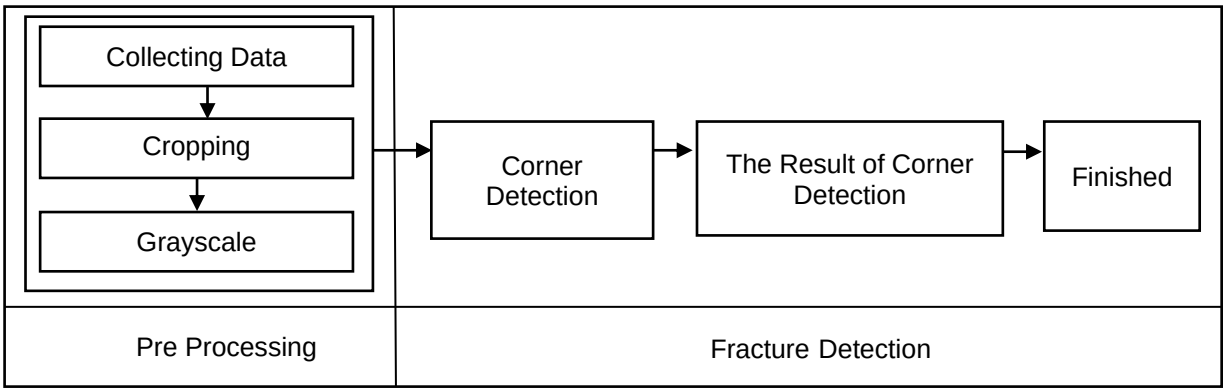
Note:

R_H = the value of Harris detector

k = constant sensitivity of Harris corner detector method

3. Research Methodology

The fracture detection program consisted of some stages like pre-processing and processing.



3.1 Collecting Data

The process of collecting data was firstly submission to collect data of bone fractures to the director of PKU Muhammadiyah Tegal represented by Human Resource Department (HRD). Then, it was in Radiology.

3.2 Cropping

Cropping was deletion of part of images to take some desired images. The process of cropping was conducted manually using application of Microsoft Office Picture Manager.

3.3 Grayscale

The next process was grayscale. Grayscale was the process of changing a color image into a gray image. The change of color pixel images into gray pixel images was as follows.

27	27	28	28	27
27	28	28	28	28
28	28	29	29	29
29	29	30	30	30
29	30	31	31	31

Figure 3. The Value of Red Pixel (R)

27	27	28	28	27
27	28	28	28	28
28	28	29	29	29
29	29	30	30	30
29	30	31	31	31

Figure 4. The Value of Green Pixel (G)

27	27	28	28	27
27	28	28	28	28
28	28	29	29	29
29	29	30	30	30
29	30	31	31	31

Figure 5. The value of Blue Pixel (B)

The process of discoloration applied the following formation.

$$Grayscale = \frac{R + G + B}{3}$$

Thus, the values of grayscale pixel in bone 1 were:

27	28	28	28	27
27	28	28	28	28
28	29	29	29	29
29	29	30	30	30
30	30	31	31	31

Figure 6. The Value of Grayscale Pixel

3.4 Processing

In the research, it has conducted the examination in software system of bone fracture detection using corner detector method. There were 10 bone fractures for the fracture examination. For the calculation, it took 1 bone.

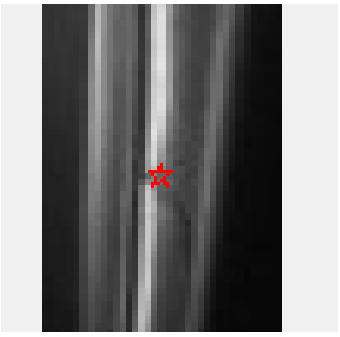


Figure 7. Bone Fracture in Bone 1

In the experiment of bone 1, bone fracture detection used corner detector with sigma parameter of 0.15 and constant sensitivity combination (k) of 0.04. The result was like on figure 7, bone fracture was detected and tagged by red star sign.

Bone fracture in bone 1 could be detected because the fracture has more than 0 of R_H pixel. The value was calculated by using the following formulation.

$$R_H = \det(M) - k * trace^2(M)$$

$$M = \begin{bmatrix} A & C \\ C & D \end{bmatrix}$$

The value of M pixel was from the matrix of bone 1; the value of A pixel = 60493, D = 12437 and C = -10485. The values were obtained from R pixel which have 1 of the value.

		R	S	T
		:	:	:
		:	:	:
71	.....	0	0	0
72	.....	0	0	0
73	.....	0	1	0
74	.....	0	0	0
75	.....	0	0	0

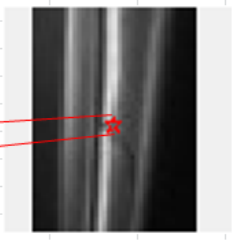


Figure 8. The Value of R Pixel in Bone 1

		R	S	T
		:	:	:
		:	:	:
71	.....	123950	90297	48374
72	.....	117660	80115	45494
73	.....	94465	60493	34982
74	.....	61298	36589	19777
75	.....	42428	20435	12928

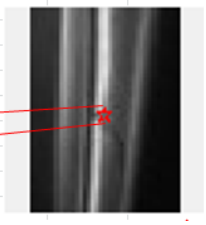


Figure 9. The Value of A Pixel in Bone 1

		R	S	T
		:	:	:
		:	:	:
71	.....	411	251.75	241.75
72	.....	289	867.75	1430.5
73	.....	5554.8	12437	12942
74	.....	6494.5	14861	14450
75	.....	12293	11715	5323.5

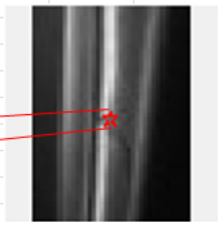


Figure 10. The Value of D Pixel in Bone 1

		R	S	T
		:	:	:
		:	:	:
71	.....	4651.8	3485.3	2400.8
72	.....	-3173.3	-518.25	5289.3
73	.....	-17207	-10485	13973
74	.....	-17729	-11444	12635
75	.....	9752	-156.5	15

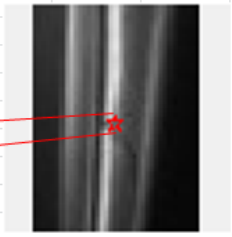


Figure 11. The Value of C Pixel in Bone 1

After found the value of each pixel, it was counted the corner detection.

$$M = \begin{bmatrix} 60493 & -10485 \\ -10485 & 12437 \end{bmatrix}$$

Det (M) = AD – CC

= $(60493\ x12437) - (-10485x - 10485)$

= 642416216

Trace (M) = A+D

= 60493 +12437

= 72930

Trace^2 (M) = 5318784900

k = 0.04

R = det (M) – k(trace^2(M))

= 642416216 – 0.04 (5318784900)

= 642416216 – 212751396

= 429664820

R value was more than 0 (R> 0). Thus, the pixel was a corner by system and the value was 1 on R pixel.

4. Result and Discussion

The application of corner detector method could detect bone fractures. However, there were bone fractures which were not detected by the application. The following table was details of bone fracture detection of 10 images.

No	Images	Fracture Number	Detected Fracture
1	Bone 1.jpg	1	1
2	Bone 2.jpg	3	1
3	Bone 3.jpg	2	1
4	Bone 4.jpg	2	1
5	Bone 5.jpg	2	1
6	Bone 6.jpg	2	2
7	Bone 7.jpg	2	2
8	Bone 8.jpg	2	1
9	Bone 9.jpg	2	1
10	Bone 10.jpg	3	3

The result was in 70% accuracy; the value was obtained from number of bone fractures compared with number of detected bone fractures by the application. The number of bone fractures was 20, while 14 was the number of detected bone fractures by the application. That result was multiplied by 100%.

There were some bone fractures which were detected by the application because of some factors. They were H value on bone fracture pixel was more than 1; image resolution was less big so that obtained images were less detail; nois on the image caused not detected fracture; and the high brightness of image gave fractures which were not detected.

5. Conclusion

The obtained result by applying Harris corner detector method to detect bone fractures was good enough with 70%. Harris corner detector method could be applied to detect bone fractures.

References

[1] Elfrida, *Identifikasi Lokasi Fraktur Pada Citra Digital Tulang Tibia Menggunakan Metode Algoritma Scanline*. Universitas Sumatra Utara, 2016.

[2] Darma, *Pengolahan Citra Digital.PDF*. Yogyakarta: Andi, 2010.

[3] R. Candra, N. Santi, S. Pd, and M. Kom, “Mengubah Citra Berwarna Menjadi Gray - Scale dan Citra biner,” vol. 16, no. 1, pp. 14–19, 2011.

[4] A. Kartono and D. Alamsyah, “Verifikasi Tanda Tangan Dengan Algoritma K-Nearest Neighbor dan Ekstraksi Ciri Harris Corner,” no. x, 2012.