Image Contrast Enhancement in CT SCAN for Determining Cervical Cancer Area

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Abstract. The quality of the contrast enhancement, which is deemed to be vague in contrast between one region and another, is a problem that many doctors face once identifying their patients with CT scan images. Image correction was used in this study to help doctors gain good CT scan images. In addition to reducing errors in the administering of radiation doses during treatment, accurate images are used to locate and assess the extent of cancer in patients. In this study, a computer application program to improve image contrast was created using the linear regression equation method. In this investigation, the cancer area is still being manually marked by doctors. Additionally, the proportion of the cancer area in the image that the doctor marked from the corrected image is calculated by comparing the ratio of cancer pixels to body pixels. The severity of the cancer is estimated using the proportion of the affected area. The error percentage for the average improvement in application performance is 0.15689%.

INTRODUCTION

Degenerative is a condition caused by the sufferer's lifestyle, such as diet, which foods are frequently ingested, activity, cigarettes, alcohol, and others. Degenerative disorders include stroke, cardiovascular disease, kidney problems, diabetic, cancer, tumours, and others. It is common to find tumors in both industrialized and poor nations. The need for an efficient examination and therapy is growing along with the amount of tumor patients each year in order to enhance the healing process. One of the leading causes of death in the globe is cancer.

Before beginning medical care, the patient is examined to determine what sickness he is experiencing with or where it is situated. The doctor typically performs the examination using a CT scan (computed tomographic scan), which generates images of the human body's interior that can be studied to establish the tumor's location and size. The patient can also begin the primary treatment, which is typically radiation therapy, after determining the extent and the size of the tumor.

The quality of scanning medical data, which are gray-level digital photos, typically degrades due to outside influences (noise) and the medical devices employed. As a result, gray-level image processing methods must be used during the image enhancement process. The process of enhancing the image's quality, which attempts to create an image that is superior to the original image, is also necessary. Hence, in order to help medical professionals interpret image results, the procedure of assessing the quality of CT scan images is vitally important (Oky Dwi Nurhayati, 2008).

Doctors confront various obstacles when using CT scan results to diagnose disorders in their patients. In the hospital is one. Dr. Soetomo Surabaya is able to locate the cancer or tumor even though a CT scan may make the area where the growth is sometimes hazy and difficult to notice. Better tests can be performed using MRI (Magnetic Resonance Imaging), however MRI is highly expensive, and patients from the middleclass cannot afford it.

The downside of Computed tomography so far is that the visual results are not crisp enough to be in terms of brightness, causing doctors to have difficulties identifying the color of cancer from normal tissue. Noise during photography can sometimes result in a lack of sharpness in the captured image. The image results from CT scans are now regarded as optimal in the medical profession since there is no technology available to date to enhance image quality. In order to discern in between colors of one network and then another network, it is therefore important to improve the image quality.

Aside from that, it is vital to use the linear regression technique and scientific methods to enhance CT images, specifically image contrast, for malignancy or malignancies and their extent. This research is essential since this results of CT scan pictures can be utilized to detect the exact size and location of the disease or tumor so that, subsequently in therapy, errors in selecting the location and amount of the disease or tumor area can be avoided.

LITERATURE REVIEW

X-ray interaction with matter

High-energy electromagnetic radiation is what X-rays are. When electrons move quickly and come into contact with other electrons or the nucleus of a substance with a high atomic number, X-rays are created. This interaction can lead to a collision wherein the electron loses energy, and it is this energy that generates electromagnetic waves known as photons. These electrons go to a higher shell or are stimulated to make it easier for them to be shot with photons from the outside when they are in the ground state (the photoelectric effect). Because the state in the upper shell is unstable, the electron attempts to become stable by returning to the ground state to fill the hole, which is known as a transition. During this transition, electrons emit X-rays (Hoskin, 2012).

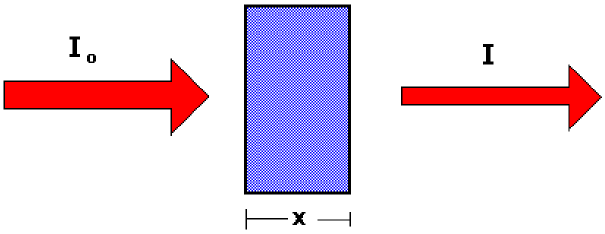

FIGURE 1. X-Ray Intensity When Objects Pass

$$I = I0 \exp(-\mu x) \quad (1)$$

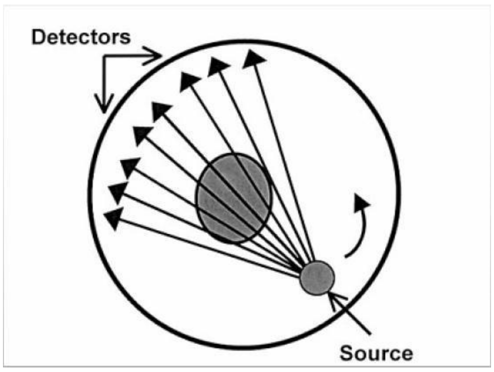

FIGURE 2. Principles of Fourth Generation CT

The fourth-generation computerized tomography (CT system is nearly identical to the third generation, which employs a rotational approach, except the detector surrounds the entire object.

X-ray interaction with matter

Fundamentally, the reconstruction method involves an inversion from sinogram space (radon space) to image space (Cartesian space). The method is flexible in terms of computation and analysis, and iterative linear equation solving is used. The summation convolution filtered backprojection (SCFBP) method is one of the picture reconstruction techniques. The two main components of the SCFBP reconstruction process are the previously completed convolution by the filter to the projection process and the back-projection process (inversion) from the sinogram space (radon) to the image space (cartesian). This is how the analysis can be expressed :

$$\mu(x,y) = \int_0 p'(\emptyset, x_r)\, d\emptyset$$

With

$$p'(x_r, \emptyset) = \int_{-\infty}^{\infty} p\,(x'_r, \emptyset) h(x_r - x'_r) dx'_r = p(x'_r, \emptyset) * h(x_r - x'_r)$$

Where $h(xr)$ is the convolving filter. The computational discrete form of the equation can be written as:

$$\mu[i,j] = \Delta\emptyset \sum_{m=0}^{m=M-1} p'[i\cos(m\Delta\emptyset) + j\sin(m\Delta\emptyset), \mathrm{m}]$$

$$p'[n,\ m] = \Delta x_r \sum_{n^F=-N}^{n^F=+N} p[n', m] h[n - n']$$

By weighting factor:

$$h(n\Delta x_r) = \begin{cases} \frac{1}{4x_r^2} & n = 0 \\ 0, & n = \text{even} \\ \frac{-1}{n^2\pi^2\Delta x_r^2} & n = \text{odd} \end{cases}$$

Contrast Changing

Changing the contrast of an image is the process of setting the range interval value at each gray degree value, and is defined by:

$$v = \frac{(x - x_{min})}{(x_{max} - x_{min})}\ .255$$

So that the gradient values m and c from the equation above are:

$$m = \frac{255}{x_{max} - x_{min}}$$

$$c = \frac{255 x_{min}}{x_{max} - x_{min}}$$

RESEARCH METHODOLOGY

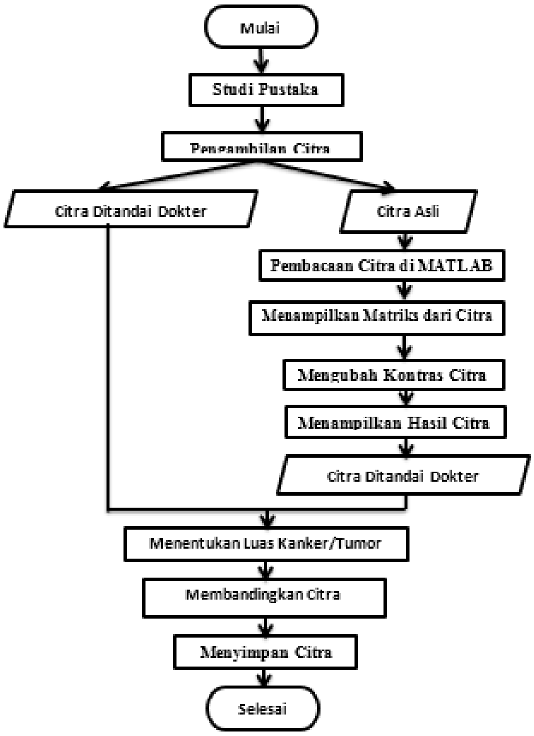

FIGURE 3. Flowchart of research procedures

RESULT AND DISCUSSION

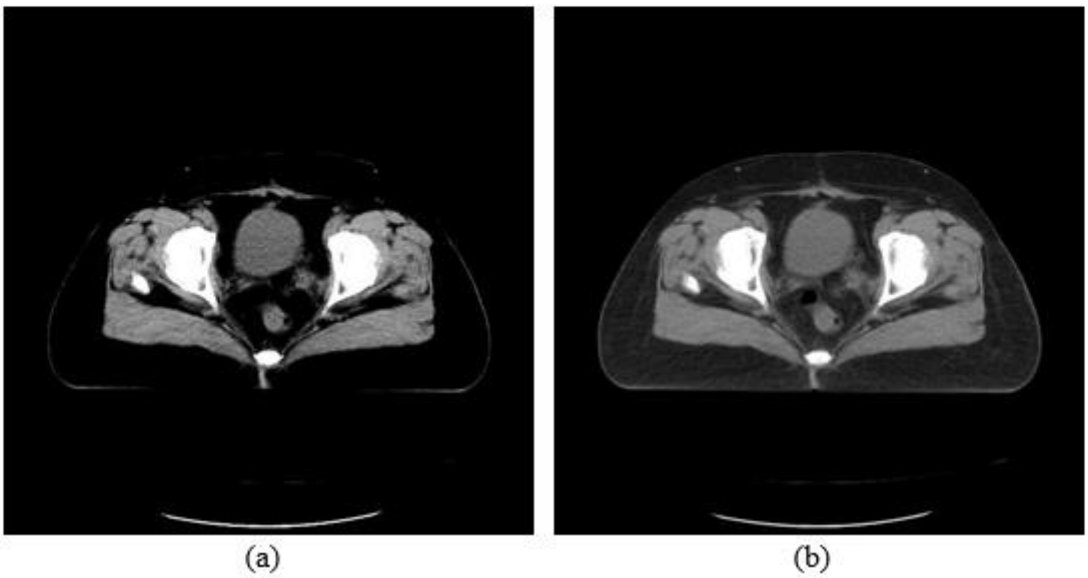

FIGURE 4. (a) Image before contrast enhancement (b) image after contrast enhancement

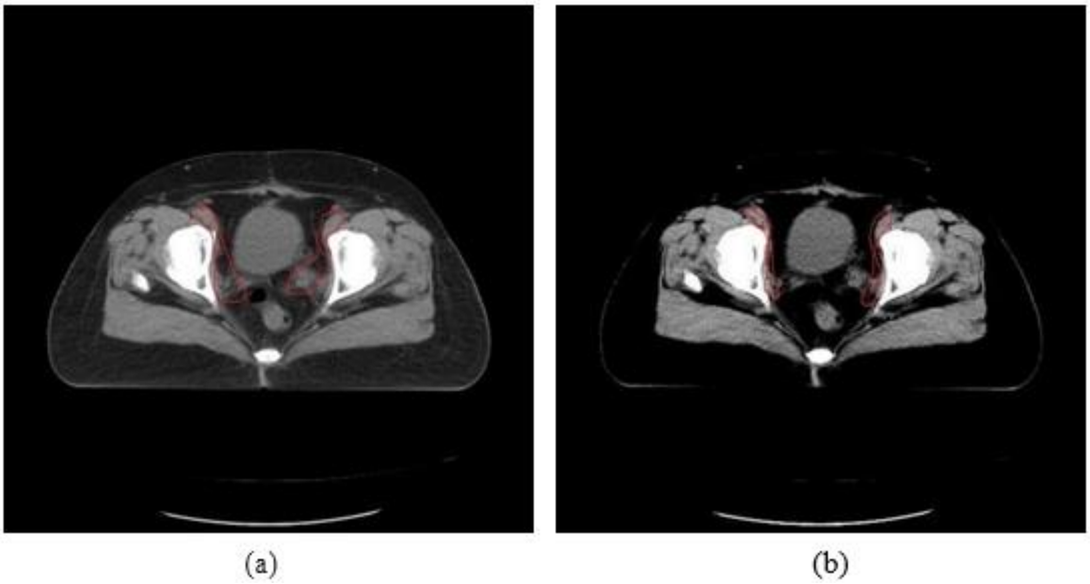

FIGURE 5. (a) The initial image is marked by a doctor, (b) the final image is marked by a doctor

$$\text{Area} = \frac{\text{Cancer pixel amount}}{\text{Body pixel amount}} x100\%$$

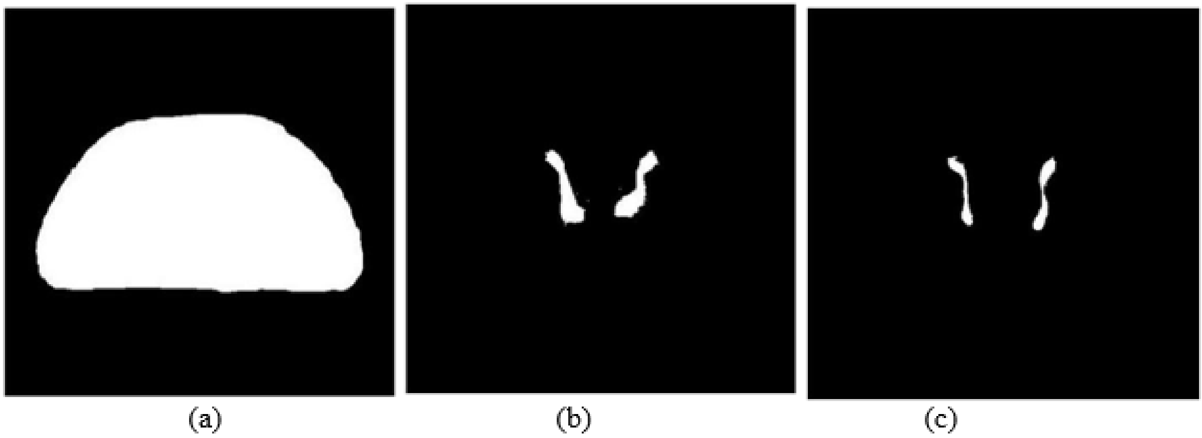

FIGURE 6. (a) body area (b) cancer area before contrast repair (c) cancer area after contrast repair

The cancer area marked by the doctor appears larger in image (b) before contrast improvement, and smaller in image (c) after contrast repair.

Before fixing the contrast

$$\text{Area} = \frac{\text{The amount of cancer's pixel}}{\text{The amount of body's pixel}} x100\%$$

$$\text{Area} = \frac{3454}{82107} x100\%$$

$$\text{Area} = 4{,}2067\%$$

or

$$\text{Area} = \text{pixel amount } x\ 0{,}1\ cm^2$$

$$\text{Area} = 3454\ x\ 0{,}1\ cm^2$$

$$\text{Area} = 345{,}4\ cm^2$$

After correcting the contrast

$$\text{Area}= \frac{\text{Cancer pixel amount}}{\text{Body pixel amount}} x100\%$$

$$\text{Area} = \frac{1817}{82107} x100\%$$

$$\text{Area} = 2{,}2129\%$$

or

$$\text{Area} = \text{pixel amount } x\ 0{,}1\ cm^2$$

$$\text{Area} = 1817\ x\ 0{,}1\ cm^2$$

$$\text{Area} = 181{,}7\ cm^2$$

So in Figure 5, the area of the cancer is obtained. Before being corrected, the contrast was 345.4 $cm2$ and after being corrected, the contrast was 181 cm^2.

TABLE 5. Ten data slices were taken in this study, and the results of the cancer area of each slice

Data to- :	**Area (cm^2)**		**Area (%)**	
	initial	final	initial	**final**
1	133,6	142,1	1,7534	**1,8650**
2	0	0	0	**0**
3	86,1	86,3	1,1313	**1,1339**
4	68,9	68,4	0,9081	**0,9016**
5	345,4	181,7	4,2067	**2,2129**
6	434,5	342,3	5,1919	**4,0902**
7	400,2	397,1	4,7603	**4,7234**
8	403,9	404,9	4,7032	**4,7148**
9	432,6	414,8	5,0078	**4,8017**
10	**401,3**	**358,6**	**4,6060**	**4,1159**

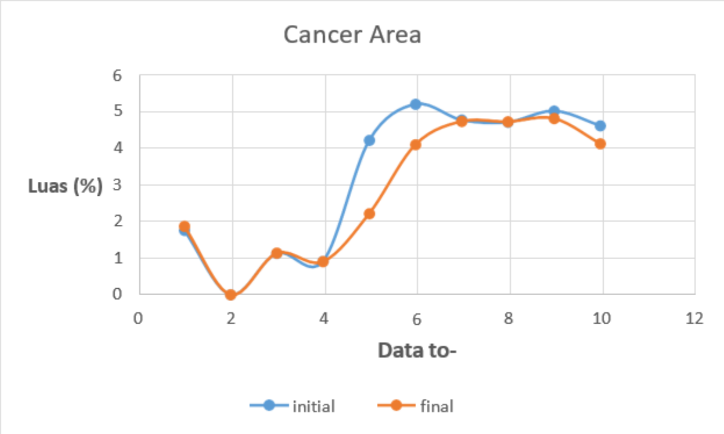

FIGURE 1. The graph also includes an analysis of calculating the area of cancer from 10 slices

The efficiency of application performance to estimate the severity of cancer

Doctors evaluate the performance of the program designed to determine the extent of cervical cancer in terms of its effectiveness. For starters, the program used to improve image contrast so that it is better and more readable by doctors is thought to be more useful in determining the location of the cancer. The doctor claims that after using the developed program to repair the damage, the contrast is better, the bones are whiter, the muscle structures are more visible, and the edges of tumors and other organs are easier to distinguish..

CONCLUSION

1. In this study, the linear regression method was used to optimize CT scan images for better contrast, and the result was a computer application program that should help doctors get better contrast.
2. A software to compute body area and a program to calculate the area of the cancer make up the application program used to pinpoint the location of cervical cancer. The percentage of the cancer's size to the total body area is the cancer area that was determined.
3. Getting a better contrast is made possible by the application or program's performance efficacy as designed by the doctor, in order to decrease administration errors for radiation doses. The program's performance effectiveness of 0.156890% has resulted in an increase in the percentage of errors made by the program between photos taken before and after contrast adjustment.

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