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A Study and Analysis of Bone Fracture Detection Methods

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ABSTRACT

Image processing is famous in modern data storage and data transmission especially in progressive transmission of images, video coding (teleconferencing), digital libraries, image database, and remote sensing. Nowadays image processing is widely used in medical image processing which comprises medical image enhancement and visualization, and edge detection. One of its major applications is fracture detection using X-ray images. Fracture in bone occurs when an external force exercised upon the bone is more than what the bone can tolerate or bear. The fracture can occur in any bone of our body like wrist, heel, ankle, hip, rib, leg, chest etc. In this paper we discuss about the types of bone fracture that commonly occur, types of filters we can remove the noise from degraded image and the edge function is used to detect edges, which are those places in an image that correspond to object boundaries.

Keywords: Bone Fracture, Medical Imaging, Edge Detection, X-ray images.

I. INTRODUCTION

Medical imaging is the technique of crafting visual representations of the internal parts of a body for clinical analysis and medical intervention, as well as visual representation of the function of some organs and tissues. As per the last years, the amount of medical image data grew from Kilo- to Terabyte[1]. The method of processing the medical image further for the better view by using the image processing technique is called Medical Image Processing. This is mainly due to improvements in medical image acquisition systems with increasing pixel resolution and faster reconstruction processing. Radiations are passed through the body of the human to view take images of the interior portion of the human. There are two types of radiations are used. They are ionising radiation and non-ionising radiation. Ionizing radiation in medical imaging embraces x-rays and γ-rays. X-rays are mainly taken to view the bones. The most common ailment of human bone is fracture [2]. A bone fracture is a

Medical condition in which there is a break in the continuity of the bones. Sometimes fracture is not clear in x-rays, Image processing helps in such cases to detect fracture. Computer detection of fractures can promote the doctors by flagging suspicious cases for closer examinations and thus improve the timeliness and accuracy of the diagnosis.

II. TYPES OF BONE FRACTURE

The human body has 206 bones with various shapes, size and structures. The common problem for the bone is fracture. Fracture in bone occurs when an

external force exercised upon the bone is more than what the bone can tolerate or bear. Depending on the impact of the force, some of the fractures are more terrible and dreadful than others. Sometimes the specific bone involved, and the age of the person and general health conditions also determine the severity of the fracture.

Comminuted fracture:

A comminuted fracture is a break or flake of the bone into more than two fragments [3]. It is caused by high-impact trauma such as in vehicular accidents. Treatment: a comminuted fracture often requires open surgery to restructure the bone to normal anatomy [3].

Greenstick fracture:

A greenstick fracture is a fracture in a budding, soft bone in which the bone bends and breaks. The fracture usually occurs in children and teens because their bones are flexible, unlike adults whose more brittle bones usually break [3]. Treatment: Removable splints result in better consequences than casting in children with torus fractures of the distal radius.

Transverse fracture:

A fracture in which the break is among a bone, at a right angle to the long axis of the bone. Transverse fracture results from a direct blow, but it can also sporadically occur when people do things repetitively, like running. Treatment: surgically put the bone back together, and they may employ things like metal pins, plates, or screws so that the bone will stay in place and heal completely [3].

Avulsion fracture:

An avulsion fracture is an injury to the bone in a location where a tendon or ligament attaches to the bone. It is caused by the tendon or ligament pulls off a piece of the bone while the bone is moving in the opposite direction. It is more generic in children[3]. Treatment: when the shatter of bone is pulled more than numerous centimetres from its normal position does surgery need to be considered.

Oblique fracture:

An oblique fracture is a relatively common fracture in which the bone breaks diagonally. It can vary in severity, depending on what bone is affected and how large the break is. It tend to occur on longer bones like the femur or tibia[4].

Spiral fracture:

A spiral fracture (torsion fracture) is a bone fracture occurring when torque (a rotating force) is applied along the axis of a bone. It often occur when the body is in motion while one extremity is planted[3]. For eg., a spiral fracture of the tibia (the shinbone) can occur in young children when they fall short on an extended leg while jumping.

Impacted fracture:

A bone fracture in which one of the shatter is driven into another fragment[5]. An impacted fracture is when a force mashes against both ends of the bone, pushing the broken ends together.

Fissure fracture:

Fissure fracture a crack extending from a surface into, but not through, a long bone.

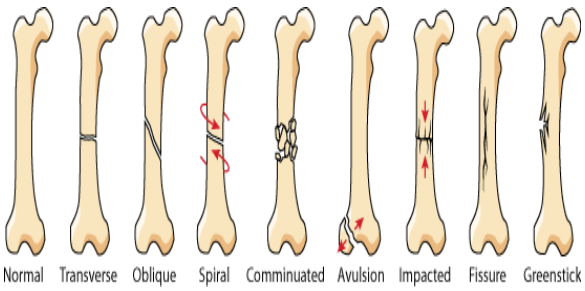


Figure 1

III. STEPS INVOLVED IN BONE FRACTURE DETECTION

By surveying various papers we concluded the steps involved to found the fractured bone. First user must give an x-ray image as an input to be processed, the image will then be carried filtering to remove noise

that exist in the image. Then, Edge detection is used for assimilation of blurred frame broad classification among smooth and rough surface classification of cement and asphalt[6]. 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 under 145 degrees, even supposing the line still has a connection with the other lines. The modules for bone fracture detection are shown in the block diagram:

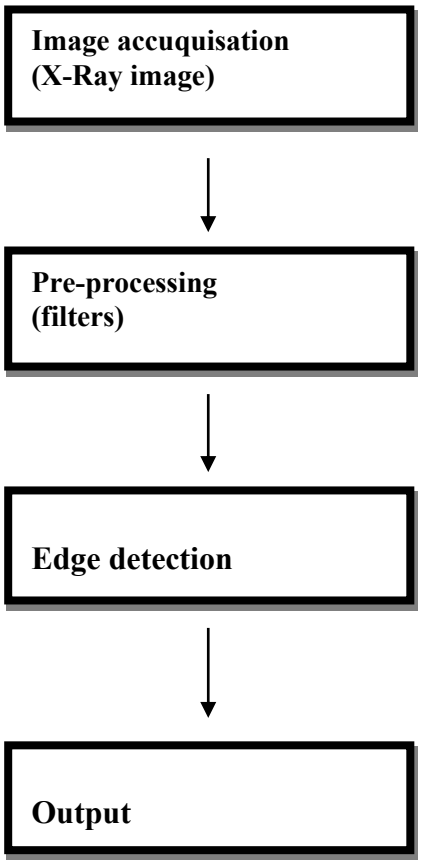


Figure 2

In the following section we discuss about the types of filters is to remove the noise from degraded image and types of edge detection function is used to detect edges, which are those places in an image that correspond to object boundaries.

TYPES OF FILTERS

Image filtering makes possible several useful tasks in image processing[1]. A filter can be applied to reduce the amount of unwanted noise in a particular image. Another type of filter can be used to reverse the effects of blurring on a particular picture. There are several types of filters exsist some of them are discussed below.

Mean filter:

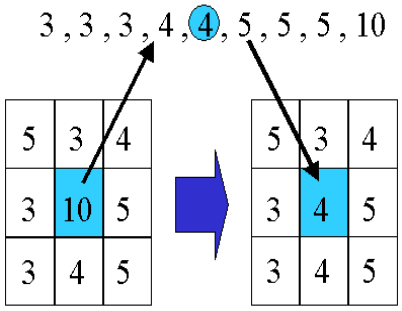
Mean filtering is a simple, intuitive and easy to implement method of smoothing images, i.e. reducing the amount of intensity distinction between one pixel and the next. It is often used to reduce noise in images[4].

1/9	1/9	1/9
1/9	1/9	1/9
1/9	1/9	1/9

Two main botheration in the mean filter is that a single pixel with a very unrepresentative value can significantly affect the mean value of all the pixels in its adjacency[7]. When the filter adjacency straddles an edge, the filter will interpolate new values for pixels on the edge and so will blur that edge. This may be a squeeze if sharp edges are required in the output.

Median filter:

Median filtering is to run through the signal entry by entry, redressing each entry with the median of neighboring entries. It is a nonlinear operation often used in image processing to reduce "salt and pepper" noise[2]. It is more effective than convolution when the goal is to synchronously reduce noise and preserve edges.



Weiner filter:

The Wiener filter is a filter used to produce an compute of a desired or destination random process by linear time-invariant (LTI) filtering of an observed noisy process, assuming know stationary signal and noise spectra, and additive noise[11]. The Wiener filter attenuates the mean square error between the estimated random process and the desired process[9]. The original image spectrum is guessed by taking the product of X(u,v) with the Wiener filter G (u,v):

$$\hat{S}(u,v) = G(u,v)X(u,v)$$

TYPES OF EDGE DETECTION

Edge detection is an image processing technique for detecting the boundaries of objects within images[12]. It works by detecting discontinuities in brightness. Edge detection is used for image segmentation and data extraction in areas such as image processing, computer vision, and machine vision. However, the quality of edge detection is highly dependent on lighting conditions, the presence of objects of similar intensities, density of edges in the scene and noise[8]. There are different algorithms for edge detections such as Canny, Laplacian of Gaussian(LOG), Sobel and Prewitt Edge Detection.

Sobel edge detection:

The Sobel operator, sometimes described as Sobel–Feldman operator or Sobel filter, is used in image processing and computer vision, particularly within edge detection algorithms where it creates an image emphasising edges[8].

Robert cross edge detection:

The Roberts Cross operator performs a light, rapidly compute, 2-D spatial gradient measurement on an image. It thus highlights regions of high spatial frequency which often correspond to edges[10]. In its most generic usage, the input to the operator is a grayscale image, as is the output. Pixel values at each and every point in the turn out narrate the enumerated absolute magnitude of the spatial gradient of the input image at that point[5].

Prewitt edge detection:

The Prewitt operator is used in image processing, peculiarly within edge detection algorithms. Technically, it is a discrete differentiation operator, computing an resemblance of the gradient of the image intensity function. At each and every point in the image, the conclusion of the Prewitt operator is either the computing gradient vector or the norm of this vector[10]. The Prewitt operator is depended on convolving the image with a small, separable, and integer valued filter in horizontal and vertical directions and is therefore relatively inexpensive in terms of computations like sobel and kayyal operators[4]. On the controversy, the gradient resemblance which it produces is relatively crude, in exclusive for high frequency variations in the image.

Laplacian of Gaussian(LOG):

The Laplacian is a 2-D isotropic estimate of the 2nd spatial derivative of an image. The Laplacian of an image high spots regions of rapid potency change and is on account of often used for edge detection (zero crossing edge detector)[9]. The Laplacian is often assigned to an image that has first been smoothed with something approximating a Gaussian smoothing filter in order to reduce its sensitivity to noise, and hence the two version will be described concurrently here. The operator normally takes a single gray level image as input and produces another gray level image as output[9].

Canny edge detection:

Canny edge detection is a technique to take out useful structural information from different vision objects and dramatically reduce the amount of data to be processed. It has been comprehensively engaged in miscellaneous computer vision strategy[5]. Canny has establish that the demand for the application of edge detection on diverse vision systems are relatively similar. Thus, an edge detection solution to dispatch

these requirements can be implemented in a wide range of situations[12]. The general paradigms for edge detection include Detection of edge with low error rate, which means that the detection should accurately catch as many edges. The edge point detected from the operator should accurately localize on the center of the edge. A given edge in the image should only be inscribed immediately, and where possible, image noise should not create false edges[3].

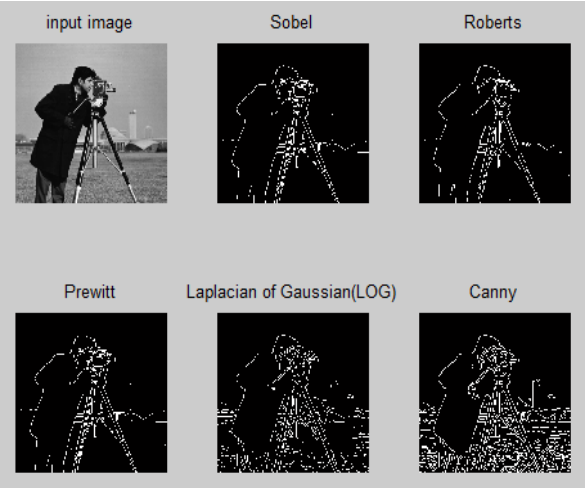


Figure 3

IV. CONCLUSION

So far we have discussed about the types of bone fracture theat commonly occur in human bones, steps involved to detect the bone fracture, types of filters and types of edge detection. For this work many bone fracture detection paper are studied. After reviewing all the bone fractured paper we concluded that the median filter is the best filter for removing salt and pepper noise and simultaneously preserves edge. We compared various types of edge detection methods such as sobel, Roberts, prewitt, laplacian of Gaussian(LOG) and canny. Among all canny edge detection is the best one widely used for bone detection because it traps the noise by creating false edge.

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