Detection of Fibroid Using Image Processing Technique

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Abstract—Magnetic resonance imaging (MRI) has become a common way to study various tumours. In this paper the magnetic resonance images of uterus is pre-processed to detect the fibroid. This paper presents a method that can successfully identify fibroid and thereby help the doctors for analyzing the size and exact location of fibroid. Uterine-cancer is one of the most common malignant gynaecological tumours which cause a serious threat to women health.

Keywords—Canny, Grayscale, MRI, Pixel, Pre-process, Scan, Tumour, Ultrasound, Uterine Fibroid.

I. INTRODUCTION

Uterine fibroids are tumours, which grow from cells forming the muscle of the uterus (womb) and occur in 20% or more women of reproductive age [10, 12]. If 100 women go for an ultrasound scan, 40-50 of them will be found to have fibroids [7]. They grow slowly within the walls of the uterus.

The medical name is leiomyoma (leio = smooth muscle, myoma = a tumour formed of muscular tissue). Pathologically, uterine leiomyomas are harmless tumours that arise in any part of the uterus under the influence of local growth factors and sex hormones, such as oestrogen and progesterone [20].

The cause of uterine fibroids is unknown. They are slow growing and may be present in the body for years before any symptoms occur [8, 11].

The gynecologist will ask for an ultrasound to accurately determine the size, number and locations of the fibroid. Some of the ultrasound scanning techniques are MRI scan, CT scan, etc.

Types of fibroid:

Fibroids can be classified according to their position in the uterus or womb:

a. Subserosal - towards the outside of the womb / uterus
b. Intramural - in the wall of the womb / uterus
c. Submucosal - towards the middle of the womb / uterus

a. Subserosal
These occur outside the wall in the outermost layer (serosa) of the uterus (womb). They can cause compression on the surrounding tissues, such as the bladder and bowel.

b. Intramural
These grow within the wall of the uterus and can cause pressure on the bladder and / or uterus and infertility or miscarriage.

c. Submucosal
As the name suggests these occur just below the lining (mucosa) of the uterus (womb) and are associated with heavy bleeding.

II. ULTRASOUND SCAN

Ultrasound scan makes use of sound waves to generate images of the internal organs of the body. A gel will be applied on the abdomen to give a good contact for the probe. The radiologist who performs the scan will move the probe over the abdomen and the image will be displayed on the screen. The scan is completely painless. A special probe may be placed in the vagina.

Ultrasound examination can show the difference between cysts and solid tumours such as fibroids. It cannot accurately diagnose the number, size or position of the fibroids. A pelvic ultrasound allows visualization of the female pelvic organs and structures including the uterus, cervix, vagina, fallopian tubes and ovaries.
The scan usually takes 10 to 15 minutes and you may be asked to wear a gown.

The ultrasound scanner looks a bit like a home computer system. There is a hard-drive, keyboard and a display screen, and a hand-held sensor. The sensor sends out sound waves and picks up the returning echoes. Pictures of the inside of your body are displayed on the screen. These pictures are constantly updated, so the scan can show movement.

Depending on your medical condition, you may have a scan of your abdominal or pelvic organs, or both.

The sound waves travel at different speeds depending on the type of tissue. An ultrasound gel is placed on the transducer and the skin to allow for smooth movement of the transducer over the skin and to eliminate air between the skin and the transducer for the best sound conduction.

III. MRI SCAN

MRI stands for Magnetic Resonance Imaging. The scan uses radio waves and very strong magnets to produce images of soft tissues. No x-rays are used.

Magnetic resonance imaging (MRI) devices can scan the inside of the body in detail, to spot even the earliest signs of cancer or other abnormalities [3, 7]. It uses a magnetic field and radio waves to take pictures inside the body. It is especially helpful to collect pictures of soft tissue such as organs and muscles that don't show up on x-ray examinations [2, 6]. MRI is accurate in diagnosing a fibroid with a sensitivity of 88%–93% and a specificity of 66%–91% [17].

One way to think of an MRI scan is a water ‘x-ray’ (although no actual x-rays are involved). Normal x-rays image calcium, so they are good to see bones.

MRI scans image water, which makes them very useful because all tissues of the body contain various amounts of water. This allows high resolution pictures of many organs and tissues to be taken that are invisible to standard x-rays.

MRI scan procedure

Generally, an MRI involves the following steps:
1. You will be asked to remove all metal objects, including watches, keys and jewels. These items must be left outside the scan room.
2. In most cases, you are asked to undress and put on a cotton gown.
3. You are instructed to lie on the scanner's table. The table then slides into the cylinder. An intercom inside the MRI scanner allows you to talk with the radiography staff.
4. It is important to lie very still. Movement will blur or distort the pictures.
5. While it is in operation, the MRI scanner makes noises such as knocks, loud bangs and clicks. (You may be offered earplugs. In some cases, you can listen to music through headphones if you prefer.)
6. The scanned area of your body may feel a little warm.
7. The scan may take up to an hour, depending on the nature of the investigation.
8. The MRI scanner is attached with a computer along with the user interface, the Fourier transformer, the signal converter, and a preamplifier. A display device and a laser printer are also included.
Different images either infectious or non-harmful are acquired from the ultrasound imaging system (MRI). The images that are acquired are completely unprocessed. The images can be in the form of JPG, PNG formats etc.

In the proposed Uterine Fibroid Investigation System, the following [1,3] are the steps implemented:

**Step 1:** Read the original images from ultrasound system or MRI.

**Step 2:** Crop the unwanted areas from the input image.

**Step 3:** Apply MIC filtering algorithm to reduce noise content.

**Step 3:** Find the end of the urinary bladder to locate the starting of the uterus within which the fibroid lies by fixing a threshold.

**Step 4:** Make a binary image by selecting dark cluster of pixels in the range 0.005 to 0.3 which constitutes the fibroid region by applying knowledge-based rules.

**Step 5:** If the number of regions is more than one, select one region by applying rules.

**Step 6:** Define a diamond-shaped region in the image by dilating the region obtained in step 5.

**Step 7:** Mark the pixels within the diamond-shaped area whose intensity falls in a specified range that is fixed according to the texture of the image.

**Step 8:** Consider the biggest region in it and crop it to remove the extensions around it, if any.

**Step 9:** Draw the contour around it.

**Step 10:** Stop

**Image Preprocessing:**

Pre-processing technique consists of two steps, namely cropping the image and removing the noise. Several filters are used for noise removal that is well established in grayscale image processing.

**Grayscale Conversion Algorithm:**

**Step 1:** start

**Step 2:** acquire the scanned image of uterus.

**Step 3:** convert colour image to grayscale

**Step 4:** convert grayscale to binary

**Step 5:** count number of pixels in the vicinity

**Step 6:** multiply pixel count with one pixel value.

**Step 7:** Stop.
Segmentation:

Segmentation is the next step applied on the pre-processed image. Image segmentation is an important process to extract information from complex medical images. The segmentation component is expressed in terms of production rules, which capture the perceptual knowledge relevant to the domain. These rules will detect appropriate boundaries.

Canny’s Edge Detection Technique

The following shows the canny edge detection algorithm steps. The algorithm runs in 5 separate steps.
1. Smoothing: Blurring of the image to remove noise.
2. Finding gradients: The edges should be marked where the gradients of the image have large magnitudes.
3. Non-maximum suppression: Only local maxima should be marked as edges.
4. Double thresholding: Potential edges are determined by thresholding.
5. Edge tracking by hysteresis: Final edges are determined by suppressing all edges that are not connected to a very certain (strong) edge.

Feature Extraction:

The goal of feature extraction is to obtain representative features that can be used to determine the mode of treatment.

The shape-based features, i.e. diameter, area and compactness, are the essential measures.

Diameter

It is measured and specified by the radiologist as horizontal and vertical diameters in centimetres. After segmenting the fibroid, the horizontal and vertical diameters are calculated in pixels and converted to centimetres.

Area

The area of the fibroid is the number of pixels inside the fibroid. It is used to specify the size of the fibroid. It can also be found by the formula $A = \pi a b/2$, where $a$ and $b$ are the horizontal and vertical diameters.

Compactness

The compactness of a region is defined as the ratio of the square of the perimeter of a region to its area, i.e. compactness = perimeter$^2$/area, where the perimeter is the distance around the boundary of the fibroid and the area is the number of pixels inside the fibroid.

Testing and Evaluation:

After all the algorithms are been performed the last & the final step is testing & evaluation of the system.

V. ESTIMATION OF UTERINE FIBROID PARAMETERS

The extracted uterine features are used to determine the mode of treatment. For instance, if the size of the fibroid is very small, it can be treated by giving medicine, whereas if the size is big, it can be cured by making use of the advanced technology called Embolization, which is a non-surgical treatment to remove fibroid from the uterus [1].

VI. CONCLUSION

This paper presents the methods in medical image processing and discussed requirements and properties of techniques in fibroid detection. This paper can be used to give more information about fibroid detection and segmentation. The target area is segmented and the evaluation of this tool from the doctor and this helps the doctors in diagnosis, the treatment plan making and state of the fibroid monitoring. In future, the system can be improved by adapting more segmentation algorithm to suit the different medical image segmentation. Using color based image segmentation; it is possible to reduce the computational cost avoiding feature calculation for every pixel in the image.

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