Breast Cancer Detection

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Citation

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Abstract

This paper presents an application of watershed algorithm for mammogram image segmentation and thereby detection of clues about the possibility of attack of breast cancer. The technique employed here is the use of watershed algorithms for image segmentation and to classify the various microstrururures in the image based on morphology technique. The algorithm uses the basic morphological concepts like erosion and dilation and they are used as markers for watershed segmentation. The software employed is Mat lab codes and the images are taken from the famous Mammogram image web gallery of mini-MIAS (mammogram image analysis society, UK)... The results are found to be satisfactory and has been validated by experts in the field of radiology. The performance of this algorithm for breast image segmentation was found to be very simple and it is felt that this technique can be applied for the detection of breast cancer at an early stage.

INTRODUCTION

A mammogram is an X-ray examination of the breast. A mammogram is used to detect and diagnose breast disease in women who have breast symptoms (problems such as a lump, pain or nipple discharge) and in women who have no breast complaints (asymptomatic).Although breasts have been X-rayed for more than 70 years, modern mammography has only existed since 1969 when the first X-ray machines used just for breast imaging were available. Since then, the technology has advanced a great deal, so that today's mammogram is very different even from those of the mid-1980s. The modern technique uses a special machine only for breast X-rays to produce studies that are high quality but have a low radiation dose (usually about 0.1 to 0.2 red doses per picture). In the past there were concerns about radiation risks; today if there is a risk, it is very small. To put the radiation dose into perspective, a woman who receives radiation as a treatment for breast cancer will receive several thousands reds. If a woman had yearly mammograms beginning at age 40 years and continuing until 90, she will have received 20-40 reds. A different type of X-ray is used for the breasts than for other parts of the body. This type of X-ray does not penetrate tissue as easily as the X-ray used for routine chest films or X-rays of the arms or legs. For a mammogram, the breast is squeezed between 2 plates to spread the tissue apart and to allow a lower dose of X-ray. Although this may be temporarily uncomfortable, it only lasts for a few seconds and it has to be done this way to produce a good mammogram. The entire procedure for a screening mammogram takes about 20 minutes. A different type of X-ray is used for the breasts than for other parts of the body. This type of X-ray does not penetrate tissue as easily as the X-ray used for routine chest films or X-rays of the arms or legs. For a mammogram, the breast is squeezed between 2 plates to spread the tissue apart and to allow a lower dose of X-ray. Although this may be temporarily uncomfortable, it only lasts for a few seconds and it has to be done this way.

Calcifications are tiny mineral deposits within the breast tissue, which look like small white spots on the films. There are two types of calcifications:

- Macro calcifications
- Micro calcifications

Macro calcifications are coarse (larger) calcium deposits that are most likely changes in the breasts caused by aging of the breast arteries, old injuries, or inflammations. These deposits are related to no cancerous conditions and do not require a biopsy. Macro calcifications are found in about half the women over 50, and in 1 of 10 women under 50.

Micro calcifications are tiny specks of calcium in the breast. They may appear alone or in clusters. Micro calcifications seen on a mammogram do not always mean that cancer is present. The shape and layout of micro calcifications help the radiologist judge how likely it is that cancer is present. In some cases, the micro calcifications do not even mean a biopsy is needed. Instead, a doctor may advise you to have a

follow-up mammogram within 3 to 6 months. In other cases, the micro calcifications look more suspicious and a biopsy is recommended.

A mass, which may occur with or without calcifications, is another important change seen on mammograms. A mass can be caused by many things, including cysts. A cyst, which is a benign collection of fluid in the breast, cannot be diagnosed by physical exam alone nor can it be diagnosed by mammography alone. To confirm that a mass is really a cyst, either breast ultrasound or aspiration (removal of fluid) with a needle is needed. If a mass is not a cyst, then you may have more imaging tests. As with calcifications, a mass can be caused by benign breast conditions or by breast cancer. Some masses can be watched with periodic mammography while others may need a biopsy. The size, shape, and margins (edges) of the mass help the radiologist to determine the likelihood of cancer. Your prior mammograms may help show that a mass has not changed for many years, indicating a benign condition and help avoid an unnecessary biopsy. Having your prior mammograms available to the radiologist, as discussed above, is very important.

A mammogram cannot prove that an abnormal area is cancer. If a mammogram raises a significant suspicion of cancer, tissue must be removed for examination under the microscope to tell if it is cancer. This can be done with needle biopsy or open surgical biopsy.

EXPERIMENT

The Mat lab codes on watershed algorithms have been developed. The working of the algorithm was tested on several mammogram images obtained from the mini-Miasma gallery. It has been found that the results of segmentation gave very good clue to a radiologist /physician to further investigate on the presence of micro calcifications in the breast tissue.

ALGORITHMIC STEPS

- Read the mammogram image, (in any suitable format).
- Adjust intensity distribution by using suitable shareholding methods.
- Group individual cells under different colors.
- Extract detected small structures.
- Detect edges of small objects.
- Characterize no uniform background using morphology.
- Remove background by image subtraction.
- Segment after background removal.
- Extract new areas and update distribution.
- Compare distributions.
- Remove partial segments from cutoff segments.
- Redo size distribution again after border cleaning.
- Compare the first order statistics of the segmented image.
- Finally indicate the detected microcalicifications.

EXPERIMENTAL RESULTS

This section gives the result of application of the watershed algorithms on some sample Images. Figs 1, 2 &3 shows the various stages in image segmentation

Figure 1

Figure 1: Segmentation of mammogram image Br1.

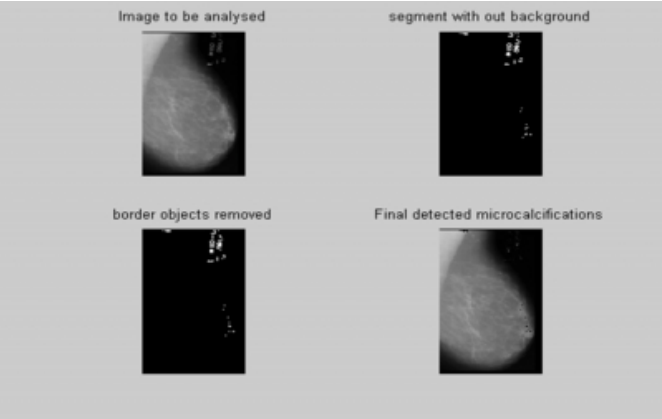


Figure 2

Figure 2: Segmentation of image Br2

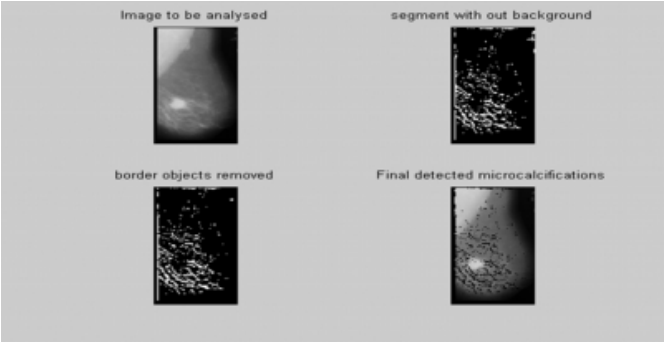
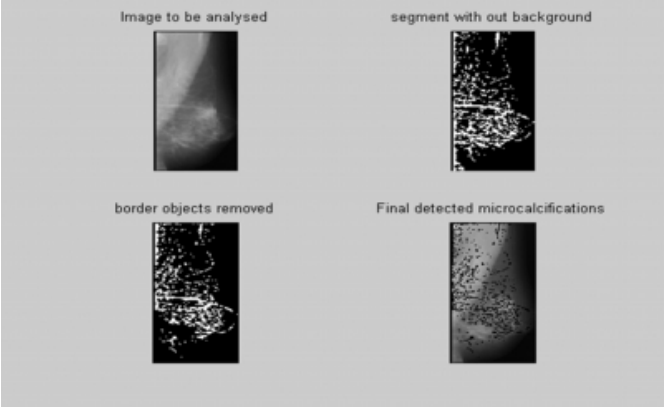


Figure 3

Figure 3: segmentation of image Br3



The images are obtained from mini-MIAS and some pilot study has been done at present we are validated the results by visual observation only. We are planning to employ some statistical means to arrive at some better clue about the quantity of cancer affected area also. The images were preprocessed by the use of suitable filters.

The above algorithms were applied on to a set of 3 mammogram images and the details of image features obtained are as shown in table1.

Figure 4

Table 1: Table showing the first order statistics of the tested images.

Image no.	Mean of A	STD of A	Mean of A2	STD of A2	Mean of A3	STD ofA3
BR1	7840	0	7840	0	NAN	NAN
BR2	0.8052	2.8820	0.0610	0.0070	0.0061	0.0070
BR3	3.8320	6.3460	0.0066	0.0181	0.0065	0.0182

The table gives the statistical image properties of each mammograms and it can be seen that the presence of micro calcification may be approximated to appear in images BR2and BR3. This may be a figure of merit for a physician to decide about the formation of cancer cluster tissues in the breast. The area of dense tissue are designated as A, (original image), A2 and A3 as the area of dense tissue before and after segmentation.

CONCLUSION AND FUTURE WORK

This is a basic and an easy technique to segment a mammogram image. This may give a clue for a radiologist and to decide about the future course of action in case of any abnormal growth in the breast tissue.

Our future work include to model the fibro-glandular disc tissue of the breast and to make image analysis to identify the cancer cells or any micro calcifications. We are trying to model the breast tissue based on Gaussian Mixture Model and to classify the tissues under various categories by the use of Expectation Maximization (EM) algorithm.

References

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