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Segmentation of Ovarian Cancer using Active Contour and Random Walker Algorithm

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***Abstract* - Image Processing nowadays has been commonly used in different medical fields and includes many types of techniques such as storage, communication, presentation, extraction, detection, image gaining, and surgical planning which helps in improving early detection and treatment stage. Early detection is easier in the treatment especially in the case of ovarian cancer.**

Ovarian cancer has become one among the frequently occuring diseases in 1 in every 8 women these days, this increase in the number of women getting this cancer has drawn the attention of many medical communities. Statistics indicate that ovarian cancer is one of the 10 usual cancers in women. It is the deadliest gynecologic cancer and takes many lives. Early identification of this cancer is very much important for an efficacious diagnosis. There have been many algorithms used to detect ovarian cancer. Here are two algorithms active contour and random walker that are used to detect ovarian cancer and to find the better approach out of them.

Index Terms* - *Ovary, Supervised Segmentation, image segmentation, annotation.

I. INTRODUCTION

Ovarian cancer is a group of diseases that is caused by ovaries. It may get enlarged rapidly and expand to other organs of the human body in no matter of time, cancer develops and multiplies continuously producing tumors (lump of tissue). Ovarian cancer has become one among the most frequent and major health problems in the world. It may be caused due to various factors such as obesity, type 2 diabetes, and high cholesterol in the body. The disease occurs in females and mainly affects the woman who is of age group between 18 to 44 and causes complicated issues during the fertility period which decreases the mortality rate. Hence females have to be aware of leading a good and healthy life. The earlier the detection the successful the treatment is.

The risk gets higher as and when the age of women increases. It is seen mainly in women at the age of 50 and is at lower chances of getting cured. One of the main reasons is that this type of cancer is so deadly as in the starting stage it hardly has any symptoms. During the initial stage, no symptoms are observed whereas at later stages the symptoms are associated with loss of appetite and weight loss as symptoms which can be non-specific abdominal pain, frequent urination, kidney pain are some of the advanced ovarian cancer symptoms This reason makes it get undetected until it's too late and has a high risk of losing a life. 1 in 78 women is at risk of getting ovarian cancer.

With the most common form of malignant epithelial carcinogen, the cancer cells can grow out of control and can quickly spread from a couple of weeks to a couple of months. The different types of ovarian cancer has reached more than 30 in number. They all start in either in one ovary or at times in both the ovaries or there are even chances for it to develop in the nearby fallopian tube of the uterus. Most ovarian cancers are classified by the name of the cell from where the disease originated. The purpose of this paper is to find ovarian cancer in the CT image and give more accurate results by various enhancement and segmentation techniques such as active contouring and random walker algorithms.

The paper has been organized in the following way. Section II includes the literature survey, Section III tells about the methodology, Section IV explains about the results and discussions and Section V gives the conclusion of the paper.

II. LITERATURE SURVEY

Ashika Raj et al.[1] used fuzzy c-means for automatic identification of cysts in PCOS patients using images of ovary which were ultrasonic. Firstly, the ultrasonic image of the ovary was enhanced as the input and later denoising was done using soft thresholding. To improve the clarity and quality of the input image a morphological approach was implemented for contrast enhancements and an algorithm named Fuzzy c-means clustering was applied and finally, the cysts were detected. Sakshi Srivastava et al.[2] worked on a traditional model na VGG-16 model which is a deep learning neural network consisting of 16 layers and has been given training on a particular dataset. This model has the capability to identify the cysts in the given ultrasonic images of ovaries . They used fine-tuning for the ultrasound images dataset. The initial layers were fixed in the VGG-16 model except for the last four layers in the last. Hemita Pathak et al.[3] developed a system that acquired machine learning algorithms, ultrasound images, and image processing to classify the tumors into two types of ovarian cancer that are benign and malignant. It also mainly includes the some of the techniques of denoising the images namely wavelet transform, GLCM(gray level co-occurrence algorithm) where grey-level texture features are being extracted, SVM(Support Vector Machine) where extracted

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features are being trained and through Relief-F non-redundant features were selected and will be trained and tested further to determine the output SVM was used. Thangamma, Dr. Prasanna et al.[4] have analyzed different image modalities to examine texture and segmentation with techniques such as K-means and Fuzzy c means for malignant tumors. Based on the techniques mentioned above the tissue region was segmented. The results of both the case studies were analyzed for precise and efficacious treatment. Shubham Negi et al.[5], have proposed a mechanism namely non-invasive sensor for the identification of ovarian cancer. This method also gave rise to a portable device that can be utilized for early treatment of ovarian cancer and can be used conveniently. This device is built with the help of OLED which acts both as a source of light and also as a sensor for the light detection. Miao Wu et al.[6] used Computer-aided design which assists the pathologist to identify and treat ovarian cancer in a proper way. Initially, the different types of cancer are detected with the help of Alex net architecture which is based on DCNN. The manipulation of images was carried forward using different kinds of filters in order to remove the noise and get a sharp image. The respective cancer type is detected by passing the image through the module named DCNN. Beant Kaur et al.[7] considered different ovarian cancer images and performed various image segmentation algorithms and filtration using detection of edges, process of filtration to a scale of an image and clustering algorithm called fuzzy-c-means. A scale here is a filter for medical images which remains ineffective to cancer that detects a specific image. Therefore, scales are used within the range like 512*512, extraction of images of particular regions and areas were obtained by feature extraction and multi scaling algorithms.

The gaps identified were, most of the existing research work that is carried till now are on different applications of image segmentation and there is limited work on implementation of active contour and random walker algorithm for segmentation of ovarian cancer. In the past, these algorithms have been applied for the segmentation of tumors in different human organs but this research work is taken forward mainly to focus on applying random walker and active contour algorithm for the identification of ovarian cancer.

III. METHODOLOGY

A. Materials and Methods

The images used in this research work have been taken from SDM College of Medical Sciences and Hospital, Dharwad. There are of totally 250 CT (benign images were collected and taken into this research work). Study Protocols were explained to the patients and consent was taken and the entire study has been approved by the ethical committee where the research has been carried out. Out of 250 images, 140 were benign and 60 were malignant images. Patients have been informed about research work. The images were taken for the early detection of tumors in ovarian cancer. These images were initially taken and later segmented where the tumor was presented. The type of python open-source package used for the segmentation of tumors is called scikit image. Different CT scan images of a total of 250 patients were taken and evaluated for the segmentation of tumors.

B. Architecture of Proposed framework

The research is carried out using a python-based image processing library called scikit-image. Python programming is used to implement the algorithms.

Various techniques of supervised segmentation are used to segment the original image of the tumor. The two supervised segmentation techniques are Active Contour segmentation and Random Walker Segmentation which work with two different principles. In Active Contour Segmentation, the algorithm segments the small portion of the tumor where it generates the circle that defines the points to an image and initializes the snake. Later, the x y coordinate points are calculated on the boundary of the circle. Therefore, it segments the tumor by seeking the two parameters which are called as alpha and beta. The higher value of the alpha, it makes the snake decrease faster whereas beta makes the snake even and smooth. In Random Walker Segmentation, labels are initialized by several pixels. The input expects the label image by setting every label of the pixel by calculating the probability by obtaining high quality of image segmentation. Therefore, the bigger circle comprises the major portion of the tumor by probability and the smaller circle comprises near the tumor. This can be enhanced by tuning the beta parameter to get the desired portion of the tumor. Therefore, the two algorithms are compared by their segmented outputs. The proposed architecture framework is demonstrated in Figure 1.

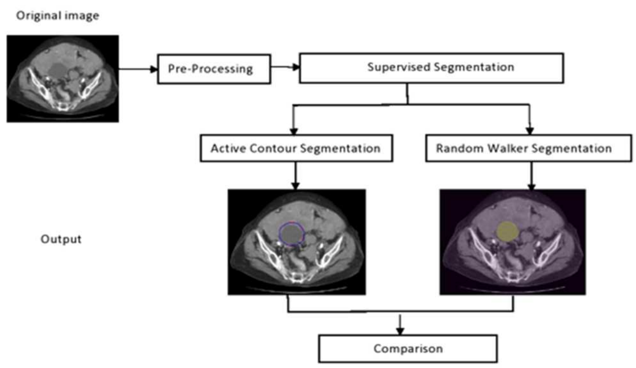

Fig. 1. *Proposed framework*

C. Algorithm

1. Active Contour Algorithm [23]

It is also called snakes. It works mainly on the predefined contour for the necessary area and the line then contracts slowly and later, attracts or even repels of lights and edges, For example, here we have drawn a circle around the tumors to configure the snake, the algorithm then segments the circled part from left over part of the image by connecting or attaching a closed curve to the edges of cancer. It is a framework for getting the required image outline contour. The framework associates the contour as the sum of both internal and external energies.The forces are combined mainly because of the and the conditions introduced by the user. The external energy expression is taken such that it is minimum at the image boundary. [24][25][26] The internal energy expression is the combination of continuity of the contour and the smoothness of the contour.

Initially, the image boundary is represented as a parametric curve by active contour. Along with this an energy function will also be associated with the curve. The issue of identifying boundaries of the image is considered as an energy minimizing problem. The snake follows a higher-intensity gradient smoothly, only if the gradient reflects the image boundary correctly. Or else a smoother outline boundary is generated connecting the region of the missing gradient.

2. Random Walker Algorithm[27]

In this algorithm, pixels of smaller numbers are labeled and are also called as labels. Each and every pixel that is not labeled is assumed to produce a random walker and then one may be able to determine the probability of a random walker, beginning from pixels that are not labelled and reaching to the pixels that are pre-labelled. The probability is calculated by allocating each pixel to the label and high-quality segmented image is obtained. [28][29][30] The algorithm will look forward to a labeled image as input and hence we will have a bigger circle that encircles most of the tumor and the smaller circle near the tumor.

IV. RESULTS AND DISCUSSIONS

When we concentrate on the results. In the figure given below the images shows the segmentation of ovarian cancer using an active contour algorithm, the results shown in the second row is the output obtained from random walker algorithm. [31][32] Hence, output obtained by random walker algorithm is more accurate than the active contour algorithm. Figure 2a, 2b, 2c, and 2d represents the results of active contour algorithm, where figure 2a is the original uterus images, figure 2b is the ground truth marked by the radiologist, figure 2c is the manually annotated image given to the algorithm and figure 2d is the final output predicted by the active contour algorithm.

Figure 3a, 3b, and 3c represents the results obtained from random walker algorithm, where figure 3a is the concentric circles assigned manually to the algorithm in which the inner circle is drawn with the confirmation that there is a tumor in that region and the outer circle is set based on an assumption that there may be an extended tumor in that region, figure 3b is the output obtained from the random walker algorithm. Hence from both the results, we can see that the Random walker algorithm shows more accuracy compared to the active contour algorithm.

Results of Active contour Algorithm:

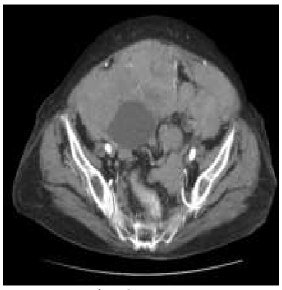

Fig. 2a.

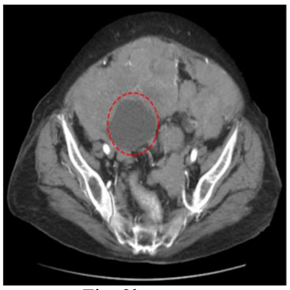

Fig. 2b.

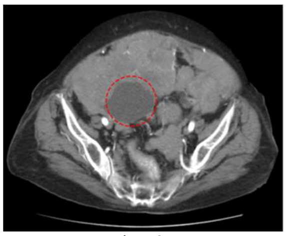

Fig . 2c.

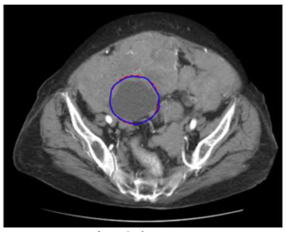

Fig. 2d.

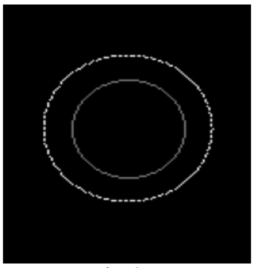

Fig. 3a.

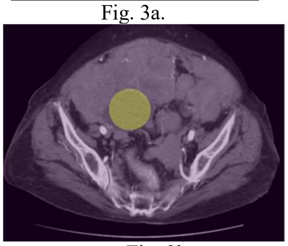

Fig. 3b.

Results of Random Walker Algorithm

V. CONCLUSION

We could successfully implement the two algorithms active contour and random walker to segment the cancer present in the uterus and when both the results are compared manually through the human eye. Random walker algorithm has been able to give more accurate results than active contour algorithm. We plan to work more and explore this regime in future work.

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