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Ovarian cancer sign, symptoms and detection techniques

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ABSTRACT

The current medical field is improved in many ways by accessing the applications of the technology. Digital image processing is one of them that being fascinating for researchers as well as for doctors such as ultrasound images and others. Due to various reasons, the diseases are growing rapidly, Cancer is one of them. Basically, cancer is a disease in which the blood cells grow uncontrollable and abnormal that causes diseases. Ovarian cancer is the most occurred form of the disease in females and every year the majority of females are survived from it. The cancer is produced in the ovaries and spread in the other parts of the body. The detection and diagnosis are crucial in the early stages because of the diagnosis become harder at the last stages. In the research, a deep representation of ovarian cancer is described as its generating process, signs and symptoms and the major causes of ovarian cancer. There are also descriptions of various diagnosis techniques that helped to discover the cancer cells and treatment of the patient.

Keywords— *CAD (Computer Aided Diagnosis), CNN (Convolutional Neural Network), MLP (Multi-Layer Perceptron) and SVM (Support Vector Machine)*

1. INTRODUCTION

In this era, the majority of females are survived from the disease of ovarian cancer that produced in the cells of ovaries. From the previous surveys and researches, it was assumed that the largest mortality rates of gynecologic cancer are noticed which affected approximately 22,280 women in the USA. The information was acquired by Ovarian Cancer Research Fund Alliances in the mid of the 2010s.

The ovaries are the women reproductive organs of almond-shaped organ situated in the right or left side of the uterus. Generally, it produced two kinds of hormones like progesterone and estrogen. These hormones are growing on the uterus and at the fallopian tubes which store the egg [1].

The normal size of an ovary is between 3cm to 5cm maximum and minimally it relies on between 1.5cm and 3cm. The thickness is around 0.5cm to 1.5 cm and the shape is just look like oval shape or almond shape.

In below figure 1 the normal ovary is shown that described the fundamental parts involved to it as fallopian tubes, ovary, vagina, fimbriae, uterus, fundus, uterine tube, endometrium, myometrium, and cervix.

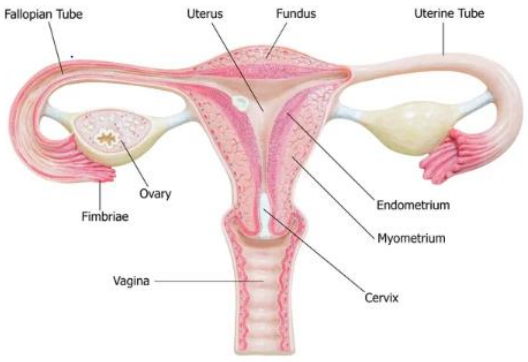

Fig. 1: Ovary structure [1]

1.1 Ovaries classification

The ovaries basically come under three categories as normal, cystic ovary and the polycystic ovary as shown as in figure 2.

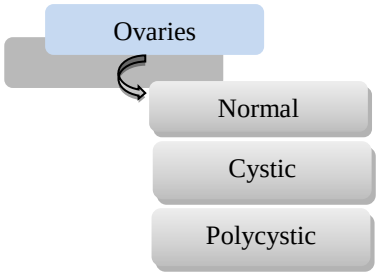

Fig. 2: Classification of ovaries [2]

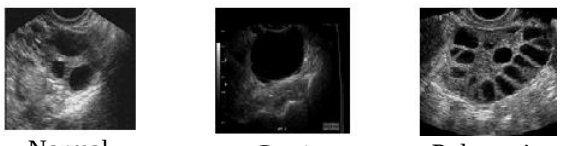

Fig. 3: Ultrasound images of three categories of ovaries [3]

The normal ovary contains 1 or 2fillicles and the size are15-10000 in pixels. The cystic ovary included the 12 and more follicles in it and the size is just less than 10mm whereas the polycystic ovary contained 12 or 20 follicles and the size of diameter is less than 9mm.

The diseases are generally the destruction or abnormal functionally of organs in the internal structure of the body as same in the case of ovaries there are various kinds of diseases as osteoporosis, ovarian cysts, polycystic ovary syndrome, and the major one is ovarian cancer [3].

1.2 Ovarian cancer

The ovarian cancer is a disease that produced in the cells of ovaries that begin to grow abnormally and in an uncontrolled manner. This kind of disease affects any age women. But the disease occurred in the women who have age between 55 and 64 years. Approximately 90% of cancer is formed in postmenopausal women. The ovarian tumor formed in one ovary or in both ovaries [4]. The stages of ovarian cancer are basically four. As per the stage level increased, the survival of the patients also increased. Subsequently, the diagnosis becomes harder.

i. Stage 1: The effect of abnormal tissues is restricted in limited areas in ovaries only.
ii. Stage 2: The abnormal tissues are moving from ovaries and distribute the relative tissues and uncontrollable cells near the uterus or to the pelvic organs.
iii. Stage 3: The effects of cancer are spread almost in the half body and reached the lymph nodes of the abdomen.
iv. Stage 4: ovarian cancer affects the body's most important organ liver and the lungs. The diagnosis at this stage is the most difficult process and the survival of the patient become more complicated [3].

The research work is categorized into different sections. Basically, there are four sections except for the conclusion. Section I is the introduction of the research work and all the information about the ovarian cancer is represented. Section II contains a description of previous research work. Section III is describing the common signs and symptoms of the ovarian tumor with their causes. Section IV included the detection and diagnosis techniques. In the end, the conclusion is the summary of complete research work.

2. LITERATURE SURVEY

The literature survey section is about the previous researches on the detection and prevention of ovarian cancer by several methods as described in the following paragraphs.

Kaur, B., et al., (2017) [5] proposed a CNN (Convolutional neural network) for the early detection of ovarian cancer stages. In this research, the focus was on the detection process of ovarian cancer along with its types, effects and causes of the diseases. Generally, the ovarian cancer was flourished rapidly over the past few decades ago, the ovaries were the organs in the women which were located in the pelvis on the right or left side. The detection of this tumor was crucial in the early stages due to the vast effects on the body and to decline the survival of the patient. Therefore, the planned approaches were utilized to enhance the images of cancer through the feature extraction and SIFT (Scale Invariant Feature Transformation). The genetic algorithm also accessed at that time for the optimization of features from a particular image of internal body captured by medical image processing. The fitness function was considered to select the best solution for a particular problem. But the accuracy-related issues were generated and CNN classifier was trained and gained the higher rate of accuracy which recorded at 98.8%. The current results were improved as compared to the previous result 85.01% by SVM (Support Vector Machine).**Nawgaje, D. D., et al., (2013) [6]** researched the hardware executable form of GA (Genetic Algorithm) for the image segmentation specifically to detect ovarian cancer. Cancer that initialized in the ovaries and produced the abnormal cells which later spread over the entire organs in the body, known as ovarian cancer. Imaging was crucial in the medical field to get the data about the internal structure of the body. Therefore, for the detection of cancer disease, imaging utilized for both detection and treatment of ovarian cancer. The concept of segmentation was to partition the images into small segments that were utilized to extract the only unique features from a particular image and basically, it was helpful for the morphological alterations in the image. For the better segmentation of the image, the focus was on the planning of an approach which was the genetic algorithm that performed on the basis of the natural selection process. The major operators of GA were selection crossover and the mutation. The fitness function was evaluated as per the variance among the target and the existing data. In this research, the implementation of genetic was completed by accessing DSP (Digital Signal Processing) (TMS320C6713). The experiment proved that the genetic algorithm was best as compared to others for the image segmentation of ovarian cancer due to the processing on a large number of images with small runtime. It was demonstrated that GA declined the run time of the processing.**Acharya, U. R., et al., (2013) [7]** recommended ovarian cancer's classification through ultrasound imaging. The computer-aided diagnosis (CAD) was mainly utilized for disease detection and had been relied on the automatic process of follicle segmentation for the enhanced understanding of ovarian dynamics. These days, the majority of females were affected by the ovarian tumor and still, the better method was considered image mining approaches. But the motive of the current research was on the enhancement of CAD systems which utilized the three-dimensional ultrasound images which had the tendency to classify the benign and malignant.The proposed work was initialized by first of all extract the features that dependent upon the textual modification and spectra data. Secondly, the decision tree was generated on the output of feature extraction. In this way, it must become to validate 1000 benign and same amount of malignant images that were acquired from the 10 patients of ovarian cancer. The parameters were accuracy, sensitivity, and specificity which were noticed at 97%, 94.3%, and 99.7% respectively. **Bhattacharjee, S., et al., (2017) [8]** represented the comparative performance of various machine learning methods on the dataset of ovarian cancer patients. The early detection and diagnosis of ovarian cancer were essential because of the high mortality rates of women were affected rapidly. The machine learning classifiers were assisted for the doctors and the researchers to create the perfect diagnosis and to decline the time and cost of the treatment process. In the current research, the machine learning classifiers were applied to the dataset of ovarian cancer patients to cure the disease in the beginning stage rather than after the long survival of the patient. The motive of current primitive work was to discover the MS (Mass Spectrometry) to obtain a CAD system. By utilizing machine learning classifiers, the data was partitioned into varied categories and identified both benign and malignant cells. Furthermore, the comparison was performed between different classifiers and it was demonstrated that MLP (Multilayer Perceptron) was performed well with the higher rates of accuracy, specificity, and sensitivity with decreased error rates whereas the other machine algorithms were decision tree, discriminant analysis, support vector machine, and neural networks. **Sazzad, T.S., et al., (2015) [9]** researched the automatic detection technique which based on the P63 digitized color images for the detection of abnormal tissues in the ovaries. There was an issue related to the reproductive tissues.

Therefore, the treatment of these problems was crucial in the process of detection of disease. The ultrasound images were capable to fix these issues, but the presence of different sizes, color and identification process was different. Hence, the automatic color images were obtained to analyze the ovarian different tissues by using a microscopic slide. The experiment depicts that the processing was quick and there was no access required to the processing parameters. The higher degree of accuracy was achieved.

Table 1: Comparison of literature survey

Author's Name and Year	Title of Paper	Technique Used	Research Parameters
Kaur, B., et al., (2017)	Ovarian cancer stage based detection on the convolutional neural network.	Convolutional neural networks (CNN)	Accuracy
Nawgaje, D. D., et al., (2013)	Hardware implementation of a genetic algorithm for the ovarian cancer image segmentation	GA (Genetic Algorithm),	A number of images, run time.
Acharya, U. R., et al., (2013)	Ovarian tumor characterization and classification using ultrasound: A new online paradigm	Ultrasound Imaging	Accuracy, sensitivity, and specificity
Bhattacharjee, S., et al., (2017)	Comparative performance analysis of machine learning classifiers on ovarian cancer dataset	Multi-layer perceptron (MLP)	Accuracy, sensitivity and specificity, errors
Sazzad, T.S., et al., (2015)	An automated detection process to detect ovarian tissues using type P63 digitized color images	P63 Digital Color Images	Accuracy

3. SYMPTOMS AND CAUSES OF OVARIAN CANCER

The symptoms of ovarian cancer in the early stages are difficult to find out. But gradually the symptoms are raised and shown on the body whereas the miner signs are missed by almost every patient. Some of the common symptoms of the disease are given below:

- Swelling on the abdomen and the body feels tired in a short while when you sit for a long time and stay in the same position.
- The problems are faced when the patient wants to eat but her body feels to be fully filled and no space for more eat.
- The periods become heavier as compared to the normal menstrual cycle.
- The other kinds of vaginal problems.
- Fatigue is another kind of sign which shown almost in each cancer patient.
- Hard pain in the stomach and in back.
- Abdominal bloating also signs of ovarian cancer.
- Changes in body weight. The weight is either gained or lost.
- The size of abdominal increased [10] [11].

The basic causes of ovarian cancer are mentioned as following:

- Old Age: the most chances of occurrence of ovarian cancer are at the old age above 55.
- Gene Mutation: there is a small proportion of ovarian tumor which caused by the mutation of genes.
- Hormone Replacement is another cause of ovarian cancer because of the nearest relations with the other hormones.
- Family History: Family history also a cause of cancer it moves from generation to generation so it matters [12].

4. DETECTION AND DIAGNOSIS TECHNIQUE

The detection of diseases at the early stages is crucial for the better diagnosis of the disease. Ovarian cancer is a harmful disease that required to be treated in the early stages of the disease to cure it. The researchers and doctors analyzed and discovered various approaches that searching the molecules in the blood that become helpful in the diagnosis of cancer diseases [13].

4.1 Ultrasound images

The ultrasound imaging is a digital image processing method that utilized in the medical field and becomes a fascinating topic. The purpose of the ultrasound is to capture the image form the internal structure of body it basically preferred for the diagnosis of various diseases and cancer is one of them. It composed of a transducer that scrubbed while applying jelly on the interested area and the transducer got the information by radio frequency and the signals have easily captured the features form the body tissues.

ROI stands for a region of interest that required to be detected by any image processing approach and it is considered as a feature recognition problem.

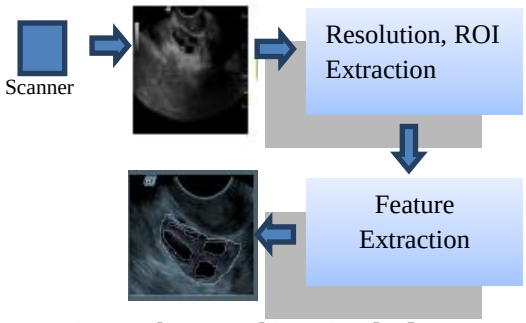

Fig. 4: Ultrasound imaging [14]

4.2 Feature extraction

It is a process to extract the information form the ultrasound images and the objective of using feature extraction process is to diminish the speckle noises and low contrast form the images to enhance the quality of an image. The ultrasound images are trained on the two methods of feature extraction as template matching and the midline detection. The template matching is a flying bat shaped approach that performed to recognize the images. The recognition performed on the entire image to capture even a small unique feature. As shown in figure 5.

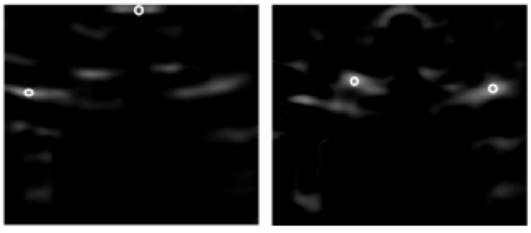

Fig. 5: Template matching [15]

The second one is midline detection that is different in the process. It begins to convert the spinous procedure to the anechoic region. It focused on the black points of features to classify the images [15].

4.3 Image segmentation

The segmentation approach is the most crucial form of image processing utilized in the medical ultrasound images. The primary function of image segmentation is to partition the entire image into small segments and then arrange the relevant images to their relevant data. There are several effects are occurred while capturing an image and these effects generate the noises and challenges that are difficult to be expelled. The segmentation relies on its other approachable methods that enhanced the performance for the better diagnosis of cancer disease. The fundamental properties of segmentation are the detection of discontinuities and the detection of similarities.

The categories of segmentation techniques are mentioned below:

- Edge-Based Approach
- Region-Based Approach
- Thresholding
- Clustering [16] [17].

4.4 Genetic Algorithm (GA)

Genetic algorithms are the metaheuristic approaches that based on the biological mechanism specifically for the reproduction. The entire algorithm is based on the fitness function and the fitness function is evaluated to find out the desired solution of a particular problem. The genetic is a natural selection criterion which performed on the basis of their operators such as selection, crossover, and mutation.

The selection operator selects the chromosome from the population and then the crossover operator utilized to obtain the new chromosomes from the previous ones. The mutation is a run-time operator that makes the alterations in the final solution if there is a lack of an important feature. For acquiring relevant data it used in medical imaging as ultrasound images for the detection of various diseases [18].

4.5 Fuzzy technique

Fuzzy operators or its method is the sub-category of artificial intelligence that applied the operators its properties, inference rules to manage the different problems occurred while the features are extracted for certain work. There is a membership function that assisted to describe the degree of some properties in the linguistic phrases.

4.6 CAD (Computer Aided Systems)

CAD is the medical imaging processes that automatically extract the features form the image while the imaging process is continued. The high order spectra are extracted by using other methods such as the support of decision tree classifier. The performance of CAD is more robust rather than others.

4.7 SVM classifiers

SVM classifier is a support vector machine that came under the machine learning techniques. The objective of SVM classifier is to detect the classification of ovaries and count the follicles in the ovary. In the medical imaging and approaches, the description of classification is easily managed by SVM. The processing speed is higher [3].

5. CONCLUSION

To finalize, the ovarian cancer is the most occurred form of cancer inwomen. The basic objective of current research is to describe all the basic information about ovarian cancer. This is a review of ovarian cancer's information. The signs, symptoms, causes and various detection techniques are explained to get the better results from it and to improve the treatment of ovarian patients. The current paper included various techniques such as fuzzy technique, ultrasound imaging CAD, SVM, MLP, image segmentation, GA and others. The motive is to enhance the procedure of detection and diagnosis of disease. The future scope is that it will become helpful in the future proposed approaches and the performance will be improved.

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