

Ovarian Cancer Detection in Computer Aided Diagnosis : A Review

Anmol Sidhant¹, Laveena Sehgal²

M.Tech (Scholar), Assistant Professor

Department of Computer Science and Engineering, Rayat Bahra Institute of Engineering , Mohali (Punjab), India

Abstract- Science and technology changed everything. Everything becomes possible due to the use of technology. The progress of science is seen all around in the world. The major areas that enhanced by technology are engineering, medical field, industrial sectors and even urbanization. In this current research, the chief focus is at the detection of ovarian cancer. The medical image processing is defined in this review work with the description of cancer. Nowadays, the ovarian cancer is the most occurred diseases in the majority of females that are required to be diagnosed at the early stages. The detection and treatment of ovarian cancer are just 50% at the initial stage. In simple terms, ovarian cancer is generated in the ovaries and at the highest stages of disease, it reached to the other parts of the body and affects the patient's body in several ways that are mentioned in the paper. It simply comes under three categories as epithelial, germ cell and stromal tumors. The review work aimed to describe the several techniques which are helpful in the diagnosis of ovarian cancer and the mentioned techniques are feature extraction, morphological operators, region of interest and principal component analysis.

Keywords- MRI (Magnetic Resonance Imaging), CAD (computer aided diagnosis), PCA (Principal component analysis) and ROI (Region of interest).

I. INTRODUCTION

The developed technology makes the efforts in each field for the betterment of well beings. Generally, the technology improved the medical image process that is playing out a crucial role in the health and welfare of human beings. The medical imaging is focused on the extraction of images for both purposes such as diagnosis and therapeutic of diseases. It is performed by the use of some enhanced sensors and the computer aided technology [1]. The advanced medical image offered the possible improvements in the medicines and the medical images. There is a variety of medical images which are varied from each other and their purposes are different. The medical imaging is simple x-ray which composed of radiation and known as electromagnetic waves. Its purpose is to capture the picture from internal body. Computer

tomography (CT scan) is utilized the x-ray to make a deep cross-sectional picture from internal body. It obtained the 3D images. MRI (Magnetic Resonance Imaging) is raised crucial medical imaging that particularly radiology based a test which accessed to the magnetic fields and the radio waves to generate the 3 dimensional images. Ultrasound is the sonography imaging. It is mainly used by the healthcare professionals. It is performed by the use of frequent sound waves to check the organs and internal structure of the body. The detection of the internal organs is done by a transducer which is a device moving on the body and it generates the sound waves that detect the tissues picture [2].

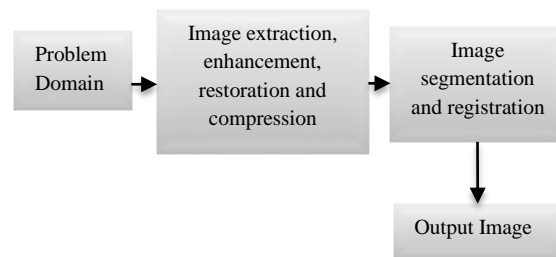


Figure 1. Medical Image Processing [2]

A. Cancer: In the current era, the cancer is prominent source of deaths and spread all around the world. The detection of this disease is unknown and diagnose in the initial stages is hard. Cancer becomes the public health issue for both males and females. Cancer disease flourished dramatically and the treatment is crucial to save the majority of people. Basically, a tumor or cancer is a set of abnormal cells in the body that grows rapidly. The effects of these cells are higher as compared to other cells and it dispersed in the whole body. Cancer is classified in various terms. It may be of any kind such as brain cancer, breast cancer, ovarian cancer and liver cancer [1] [3].

B. Ovarian Cancer: Ovarian cancer is the most common cancer disease for females. The cancer is produced in the ovary and ovaries are the female organs which located in the pelvis that looks like as almond size. The function of ovaries is to generate the eggs for the reproduction. Ovary tumor is

responsible for the highest numeral of the sort of women regenerative malignancy [4].

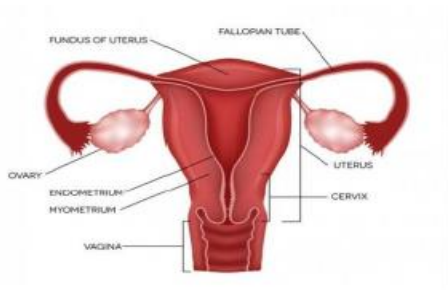


Figure 2. Ovary Structure [5]

The ovaries are oval shaped and the size is large and positioned on the either side of uterus and consists in two numbers. It generates the two sets of hormones such as progesterone and estrogen. The ovary is classified into three categories as normal, cystic and polycystic ovary. The growth of ovary is from 8mm to 10mm on average [6].

The ovarian cancer affects the whole body in different ways. The affects are commonly classified in three ways as attack, magnify and spread. It has the tendency to affect the entire closest organ near the ovary for instance uterus and fallopian tubes. Magnify is the other affect that split the tumor cells and these cells are move towards the abdomen and generate new tumors. Spread is the centric cancer which simply distributed the lymphatic system to the pelvis and chest. It has great effect on both lungs and liver. The common diseases related to ovaries are osteoporosis, ovarian cysts, polycystic ovary syndrome, polycystic ovary disease and the ovarian cancer.

Due to the invention of medical science, various kinds of techniques are accessed for the detection and diagnosis of ovarian cancer. SVM (Support vector machines) for preprocessing of data, LBP (Local binary patterns) accessed for the extraction of features from the captured image, neuro fuzzy systems are used for the classification of data. Furthermore, other many techniques are also utilized for it such as multilayer perceptron, fuzzy method, CAD (Computer aided diagnostic), genetic algorithm, etc. [5].

The review paper is organized in different sections. Each section has different content as per the title of the section. Section-I includes the general information about the science inventions on medical image processing, cancer basics and the description of ovarian cancer. Section-II is about the prior work or the previous research work related to the current research on ovarian cancer. In this section, the previous methods and results are explained. Section-III composes the

general process of ovarian cancer and the description of its symptoms and the detection procedure. Section-IV is a crucial section among the other sections which represents the feature extraction methods. Section-V is the conclusion of the overall current work on ovarian cancer detection and diagnosis.

II. PRIOR WORK

Mathieu, Kelsey. B., et al., (2018) [7] researched on screening for the detection of ovarian cancer. The researcher focused on the major imaging issues and wants to enhance the imaging technique. The process of detection ovarian cancer at the initial stages must be done approximately between 70 to 90% patients. It was noticed that, it was less than the patients who were diagnosed at the last stages. It was due to the fact of early diagnosis saved the patients in better way rather than the treatment at the last stages. Hence, the initial detection of cancer becomes crucial. In this research, the chief motive was to enhance the screening as well as the capability to uncover the ovary carcinomas. The planned technique was three stage multi-modal screening. Presently, ultrasound screens were considered as normal screens that made some delay in surgical intervals. There was a substantial aspect that gives the majority to false negatives which later increased the epithelial cells in the fallopian tubes of the ovary. The imaging of these factors or aspects were not involves. Therefore, the requirement of detection of ovarian cancer becomes essential. At current time, many researchers were working to enhance the screening that had the ability to identify the unique characteristics in the early detection of tumors. Along with this, the aim was also to make better image sensitivity particularly for the tubal lesions. The planned technique multi-modal screening was utilized when the blood assay was positive and the ultrasound at the second stage was negative. It worked to capture the missing images by ultrasound in the initial detection of ovary cancer. The result demonstrated that, the unessential operations and diagnosis declined in large amount due to the use of screening protocols such as CA125 (Cancer Antigen 125) and ROCA (Risk of ovarian cancer algorithm) with ultrasound. There was reduction of 20% in the mortality of UKCTOCS (The United Kingdom collaborative trial of ovarian cancer screening). **Spiliotis, J., et al., (2015) [8]** briefly discussed the cytoreductive surgeries and HIPEC in the recurrent epithelial ovarian cancer. The study was done on the randomized phase III. The diagnosis of ovarian cancer assists to the cytoreductive surgeries (CRS) with the systemic chemotherapies. The purpose of this study was to determine HIPEC (Hyperthermic Intraperitoneal Chemotherapy). Generally, it was another option for the treatment of the cancer patients with the second attempt of surgery and second-third chemotherapies. During 2006 to 2013, it was cleared form the survey that 120 women were affected by advanced ovarian cancer that came under FIGO III and IV (Federation

of Gynecology and Obstetrics). They survived from disease recurrence after the early diagnosis with surgeries and chemotherapies. These surgeries were segmented into two basic groups as group A which composed of 60 patients with cytoreductive surgery by HIPEC. On the contrast, group B included 60 patients diagnoses with systematic chemotherapies. The experiment demonstrated that, the group A approximately 26% against 13 months in group B. After completed three years survivals, there was third quarter (75%) for group A on the other hand, 18% for group B. In HIPEC groups, the mean survival remained same among the patients with both PRD (Platinum Resistant Diseases) and PSD (Platinum Sensitive Disease). But, in the non HIPEC group, the difference was noticed among PRD and PSD. It was proven that, HIPEC with the disease and the cytoreductive therapies were important in the treatment of patients with the recurrence of early stages. **Kuchenbaecker, K. B., et al., (2015) [9]** described the identification process of new susceptibility loci significantly for an invasive epithelial ovarian tumor. Basically, the risk of emerged epithelial ovarian cancer (EOC) was extremely higher as compared to the overall population of females treated with the disease. It represented the genetic aspects in the tumor disease susceptibility. The genome wide association study (GWAS) declared the identification of 12 EOC weakness alleles. The patterns of these loci were reliable in BRCA1 (Breast Cancer 1) and BRCA 2 (Breast Cancer 2) mutation carriers that were at highest riskless of epithelial ovarian cancer. After the imputation of 1000 genomes project information. It was associated to 11 million variants with epithelial ovarian cancer from around 15000 cases which were not selected for the family background and there were nearly 30000 controls. It was 15252 BRCA1 carriers and 8211 BRCA 2 mutation carriers. To obtain the outcome, there was a collaboration performed in the meta analysis. The planned new work was generated the framework and inclined the power and makes it applicable for uncovering new EOC weaknesses loci. **McGee, Jacob., et al., (2017) [10]** described the dangers of breast cancer after the treatment of ovary tumor in BRCA mutation carriers. The females who had inherited BRCA 1 and BRCA 2 mutation emerged the risks of tumors such as breast cancer, ovarian cancer, fallopian tube tumor and the other kind of cancers. The dangers of emerged breast cancer were to the age 70 and it was nearly 70% of BRCA1 and BRCA2. The aim of this research was to prevent the breast surgeries and MRI (Magnetic Resonance Imaging) screening. The clinical merits of these modalities had not been determined between the mutation carriers along with the background of an ovarian cancer. Therefore, the attempt was to evaluate the BRCA mutation with ovarian cancer was become beneficial from the prevention and MRI screening. The planned strategies were to evaluate the annual mortality rate for the patients who were survived from ovarian cancer. Then, the accurate dangers

breast cancer were evaluated which declined the probability of deaths with tumor. For this purpose, the Cox proportional hazards techniques were came under consideration for the determination of influences of mastectomy and the MRI on breast cancer. The results demonstrated that the 20 patients out of 509 patients were emerged the breast cancer just under 1 decade and following the treatment of ovarian cancer. The real danger of developing breast cancer was linked to the post treatment and conditional survival of the ovarian cancer. The experimental results shown that BRCA mutation patients treated with stage III and IV ovarian cancer at the age of 50. The probability of deaths under the age 80 was deducted by 1% using MRI screening. There was great enhancement in the survival of females who were already diagnosed from 10 years after ovarian cancer and also for the females who survived from initial stages as I and II ovarian tumor.

Sudarshan, Vidya K., et al., (2016) [11] explained the major applications of wavelet technique significantly for the treatment of cancer using ultrasound images. The cancer cells were produced due to the rise in the abnormal cells in the body. These were distributed in the whole body by blood cells. From the world health organization it was predicted that the most causes of deaths was because of cancer. In this research work, ultrasound imaging and the wavelet transform was utilized for the diagnosis of cancer. Ultrasound images were crucial and low cost ways to describe the internal organs of a human body and it assists to give information about the internal organs and composed of sound waves to extract the images of the organs. Later, the information acquired from the ultrasound imaging was exposed by wavelet transform. Its motive was to partition the image in the two portions and manage the images on different scales of low and high pass filters. The filters were assists to identify the alterations in the intensity in the image. The alterations were reflected in its coefficients. The proposed work described the detailed review on the wavelet transform to be useful in the diagnosis of cancer mainly for preprocessing, segmentation, extraction of features from the ultrasound images of breast cancer, ovarian cancer and thyroid patients.

III. SYMPTOMS AND DETECTION OF OVARIAN CANCER

Ovarian cancer is most frequent and aggressive gynecologic tumors. The reason behind the production of tumor is the generation of new cells which are initialized to shape superfast. The old ones are being incapable to bite the dust at the current time. This obtained the superfluity in the development of new cells that later become the causes of cancer or tumor [12]. The ovarian cancer initialized in the different four steps as in phase-1, the cancer is restricted under one or two ovaries. Phase-2, the tumor restricted to the pelvis and does not harm the other organs. Phase-3, the effect of

tumor outside of the ovaries and still restricted to lymph, abdomen. Phase-4 the disease spread to the liver also and the other parts of the body [5].

A. Common Causes of Ovarian Cancer

The overview of cancer patient’s data is displayed the count of deaths of women due to the ovarian cancer are increased as compared to the previous data. The usual causes are as-

- Gene mutation
- Damage of DNA (Deoxyribonucleic acid)
- Because of the heredity issue
- Use of alcohol and smoking.
- Excessive bleeding while menstrual cycle.

B. Signs and Symptoms of Ovarian Cancer

The signs and symptoms of ovarian cancer are mentioned below-

- Bloating and pelvic pain
- Troubles while eating
- Back pain
- Changes in menstrual cycle
- Swelling and sudden weight loss
- Urinary symptoms like urgency or fatigue
- Constipation
- Increased testosterone [13].

The increased testosterone shows the hair growth on faces as like mans.

C. Detection and Prevention Techniques

The ovarian cancer detection and diagnosis are done by several techniques. The overview of these techniques is described in the following table 1.

Table 1. Ovarian Cancer Detection and Prevention Techniques

Technique Name	Description
DWT (Discrete wavelet transform)	It simply transforms the image in some sub bands that composed of a group of data orientation and documentation. It is considered mostly to minimize the noise from the images.

SF (Statistical Features) method	In the ovarian cancer, the entire data is expressed in the form of standard deviation and mean. SF in this cancer disease displayed the four concepts (like true positive, false positive, true negative and false negative).
Morphologic tumor indexing featuring (MF)	MF considered as an effective approach which easily declined the observation variations and the output of false positive [3].
Fuzzy Technique (FT)	In this method, the fuzzy operators, mathematics and rules are used to manage the uncertainty in the issues due to the ambiguity. Its membership function assists to describe the linguistic properties.
CAD (Computer Aided Diagnostic)	It is image based spectra which used for the feature extraction, decision classifiers. CAD is robust. The online analysis of data well performed but it required more storage for offline analysis of data [5].
DNN (Deep Conventional Neural Network)	This approach simply classified the ovarian cancer image and it is intended by the supervision set.it composed of five conventional layers, 3 pool layers and 2 re-connected layers [12].

IV. FEATURE EXTRACTION METHOD

Feature extraction methods are crucial in the detection and diagnosis of ovarian cancer. For feature selection the average values of cancer patient’s sample are considered in the training set. After that the difference of two samples is evaluated. The description is accessed to locate the unique features in the image [14].

The feature extraction techniques in ovarian cancer are described in the following section-

A. ROI (Region of Interest)

The main motive of the region of interest (ROI) is to collect all the pixels of a scene image in two sets by using interest point functions. The neighbors of the pixel formed ROI. For example a pixel is set of interest point whereas other pixel is set of non-interest point. In the field of image processing, there are some gray levels which have the ability to neglect

the segmentation. Its main purpose is to generate the smooth regions which have different gray levels that are nearest to the zero [15] [16].

B. Morphological Operators

This operator is retrieved to describe a structure element of an input picture and created a same size picture from it as known as output image. In the output image, each pixel value is followed up by the compression of neighbor pixel [17]. The morphological tools are as described below-

- *Connected Morphological Operators (CMO)*: CMO simply utilized to sort out the problems which are linked to the image simplification during the processing of stabilizing data. It is better as compared with linear, median and rank order filters.
- *Region Growing Version*: It is a fundamental morphological tool which represents the watershed transformation for the image segmentation.
- *Geodesic Skeleton*: For the execution of binary images, a tool is used which is known as geodesic skeleton. The information is not generally partitioned into group of objects.
- *Interpolation tool*: usually, it varied on the geometrical techniques that reliant on the notions of geodesic distance. The motive is to merge the image models with the texture coding techniques [18].

The general work of morphological tools is to deduce the noise and detects the artifacts influenced by the image attainment and the binarization.

C. PCA (Principal Component Analysis)

Principal component analysis is a pattern recognition approach. The main purpose is to analyze the high dimensional data. Generally, to analyze the data, it is required to manage the high dimensional data into low dimensional data [19].

The major contribution of PCA is defined as-

- In PCA the eigenvalues are searched out and it is performed by a group of images.
- The eigen values are finalized by the use of eigen space in which all the faces are projected.
- The recognition process by comparing the locations of faces in the eigen spaces.

All the training images are stored in the matrix as-

$$R = \{A_1, A_2, \dots, A_n\}$$

Where R is the training images and matrix and n is the number of images stored in the images [20].

V. CONCLUSION AND FUTURE SCOPE

To summarize, a systematic study is done on the medical image processing and the ovarian cancer. The description is about the signs, symptoms, causes and detection techniques of ovarian cancer. In the current work, the focus is on various ovarian cancer detection approaches as deep neural networks, morphological operators, statistical features, fuzzy approach, discrete wavelet transform, computer aided diagnosis and other effective methods of feature extraction which enhanced the detection of cancer cells and tumor obtaining tissues in the body. The basic goal of this survey is to find out the better techniques that helped for the detection of ovarian cancer.

The future of these methods will enhance the ultrasound imaging which assists to give a better treatment at the initial stages of tumor. In this way, a large number of females relieved from such a harmful disease without any long survival.

REFERENCES

- [1] Shandilya, S., & Chandankhede, C. (2017, March). Survey on recent cancer classification systems for cancer diagnosis. In *Wireless Communications, Signal Processing and Networking (WiSPNET)*, 2017 International Conference on (pp. 2590-2594). IEEE.
- [2] Goel, N., Yadav, A., & Singh, B.M. (2016). Medical image processing: A review. *Innovative applications of computational intelligence on Power, Energy and Controls with their impact on humanity. (CIPECH-16)*. IEEE.
- [3] Rose, R. J., & Allwin, S. (2013). Computerized cancer detection and classification using ultrasound images: a survey. *Int. J. Eng. Res. Dev*, 5, 36-47.
- [4] Kaur, B., Mann, K. S., & Grewal, M. K. (2017, October). Ovarian cancer stage based detection on convolutional neural network. In *Communication and Electronics Systems (ICCES), 2017 2nd International Conference on* (pp. 855-859). IEEE.
- [5] Kore, M.R., & Phulpagar, B.D. (2016, October). A survey on segmentation of ultrasound ovarian cancer image. *International journal of innovative research in computer and communication engineering (IJIRCCCE)*. ISO 3297, vol. 4, issue 10.
- [6] Hiremath, P. S., & Tegnoor, J. R. (2013). Automated ovarian classification in digital ultrasound images. *International Journal of Biomedical Engineering and Technology*, 11(1), 46-65.
- [7] Mathieu, K. B., Bedi, D. G., Thrower, S. L., Qayyum, A., & Bast Jr, R. C. (2018). Screening for ovarian cancer: imaging challenges and opportunities for improvement. *Ultrasound in Obstetrics & Gynecology*, 51(3), 293-303.

- [8] Spiliotis, J., Halkia, E., Lianos, E., Kalantzi, N., Grivas, A., Efstathiou, E., & Giassas, S. (2015). Cytoreductive surgery and HIPEC in recurrent epithelial ovarian cancer: a prospective randomized phase III study. *Annals of surgical oncology*, 22(5), 1570-1575.
- [9] Kuchenbaecker, K. B., Ramus, S. J., Tyrer, J., Lee, A., Shen, H. C., Beesley, J., & Spindler, T. J. (2015). Identification of six new susceptibility loci for invasive epithelial ovarian cancer. *Nature genetics*, 47(2), 164.
- [10] McGee, J., Giannakeas, V., Karlan, B., Lubinski, J., Gronwald, J., Rosen, B., & Neuhausen, S. L. (2017). Risk of breast cancer after a diagnosis of ovarian cancer in BRCA mutation carriers: Is preventive mastectomy warranted? *Gynecologic oncology*, 145(2), 346-351.
- [11] Sudarshan, V. K., Mookiah, M. R. K., Acharya, U. R., Chandran, V., Molinari, F., Fujita, H., & Ng, K. H. (2016). Application of wavelet techniques for cancer diagnosis using ultrasound images: A Review. *Computers in biology and medicine*, 69, 97-111.
- [12] Wu, M., Yan, C., Liu, H., & Liu, Q. (2018). Automatic classification of ovarian cancer types from cytological images using deep convolutional neural networks. *Bioscience reports*, 38(3), BSR20180289.
- [13] Sharma, A., Singh, S., & Kumar, S. (2015). Ovarian Cancer Detection: Cause, Symptoms and Techniques. *International journal of core engineering and management (IJCEM)*. Volume 2, issue 4.
- [14] Meng, H., Hong, W., Song, J., & Wang, L. (2008, May). Feature extraction and analysis of ovarian cancer proteomic mass spectra. In *Bioinformatics and Biomedical Engineering, 2008. ICBBE 2008. The 2nd International Conference on* (pp. 668-671). IEEE.
- [15] Yang, J., & Park, D. (2004, June). Detecting region-of-interest (RoI) in digital mammogram by using morphological bandpass filter. In *Multimedia and Expo, 2004. ICME'04. 2004 IEEE International Conference on* (Vol. 2, pp. 1279-1282). IEEE.
- [16] Xia, Y., Cheng, L., Li, W., & Ning, S. (2009, July). A Region of Interest Extraction Approach Based on Adaptive Threshold in Intelligent Transportation System. In *Information Processing, 2009. APCIP 2009. Asia-Pacific Conference on* (Vol. 2, pp. 120-123). IEEE.
- [17] Hentati, R., Hentati, M., Aoudni, Y., & Abid, M. (2014, November). The implementation of basic morphological operations on FPGA using partial reconfiguration. In *Image Processing, Applications and Systems Conference (IPAS), 2014 First International* (pp. 1-5). IEEE.
- [18] Salembier Clairon, P. J., Brigger, P., Casas Pla, J. R., & Pardàs Feliu, M. (1996). Morphological operators for image and video compression. *IEEE transactions on image processing*, 5(6), 881-898.
- [19] Kaur R, Himanshi. (2015). Face recognition using principal component analysis. *International advance computing conference (IACC)*.IEEE.
- [20] Sehgal, S., Singh, H., Agarwal, M., & Bhasker, V. (2014, November). Data analysis using principal component analysis. In *Medical Imaging, m-Health and Emerging Communication Systems (MedCom), 2014 International Conference on* (pp. 45-48). IEEE.