Study of Cancer Detection Techniques Using Various Image Processing Algorithms

[1]S.Srimathi, [2]G.Yamuna
[1]Research Scholar, [2]Professor
[1]Department of Electronics & Communication Engineering,
[1]Annamalai University, Tamilnadu, India

***Abstract*--Cancer is a family of diseases caused by uncontrolled growth of abnormal cells in a part of the body. Cancer is caused by both external factors (tobacco, chemicals, radiation, and infectious organisms) and internal factors (inherited mutations, hormones, immune conditions, and mutations that occur from metabolism). Cancer is the leading cause of death worldwide. Cancer is the most costly illness and people with cancer often have high out-of-pocket health care costs. It is also often physically and emotionally difficult for those living with it and for their care providers. People who say they have had cancer are more likely to report poor health and symptoms of depression. The earlier cancer is diagnosed and treated, the better the chance of its being cured. Some types of cancer such as the skin, breast, mouth, testicles, prostate, and rectum may be detected by routine self-exam or other screening measures before the symptoms become serious. This paper analyzes the different cancer detection techniques to diagnose cancer in early stages.**

Keywords--Cancer types, Cancer detection, Segmentation

I. INTRODUCTION

Worldwide in 2000, cancer caused 6.7 million deaths or 12 percent of total. The World Health Organization estimated that if unchecked, annual global cancer deaths could rise to 15 million by 2020. Although cancer is an ancient disease that afflicts humans and other animals, its prominence in the world from the nineteenth century to become "a disease of civilization." There are several explanations of this. Cancer is primarily a disease of elders; its risk increases roughly as the fourth power of age. Thus it was less threatening when infectious diseases and grinding poverty killed before it could strike. Its turn came when gradual alleviation of harsh conditions lengthened life expectancy, first of the aristocracy then of the general population. A subtle and complex disease, it was difficult to diagnose. Identification of cases increased with development of microscopy and scientific knowledge [1]. In fact, research has shown that the survival likelihood of patients is highly related to the progress stage of the disease. As a result, an effective and precise method for detecting cancer is crucial [2]. The importance of cancer diagnosis is the fact that almost one-third of the latter group could survive if their cancer is detected and treated early. In a worldwide context, this translates into nearly 400,000 lives that could be saved every year as a result of early detection. As such, developing techniques that can help to detect and diagnose cancer at early stages can have a great impact on survival and quality of life of cancer patients [3].

II. TYPES OF CANCER

Several types of cancers were detected in recent years, and each has its ideal symptoms and treatment methods. **Breast** cancer has adversely influenced women's lives for many years. This disease has been recorded in every period of history. Ancient Greeks and Egyptians were the first groups who discovered this disease. According to the American Cancer Society, breast cancer is the most common type of cancer in women, affecting approximately 200 000 individuals every year in the United States. This disease is also the second cause of death in women diagnosed with cancer. Nevertheless, breast cancer can be treated efficiently if it is detected in the early stages. In fact, research has shown that the survival likelihood of patients is highly related to the progress stage of the disease. As a result, an effective and precise method for detecting breast cancer is crucial [2]. **Colorectal** cancer (CRC) is one the leading cause of cancer deaths in the world. Colorectal cancer is the cancer that starts either in the colon or the rectum located at the lower end of the digestive tract. The accumulation of genetic and epigenetic changes in colon epithelial cells transforms them into adenocarcinomas, which results in colorectal cancer [4]. **Skin** cancer is the most common and prevalent type of cancer over the world. Over 3.5 million cases of Melanoma, Basal Cell Carcinoma and Squamous Cell Carcinoma are diagnosed every year. This is more than the combined counts of breast cancer, lung cancer and colon cancers. In fact, a person falls victim to Melanoma every 57 seconds. As it is with every variety of cancer, early screening and detection of skin cancer is the most hopeful sign of making a full recovery. Early detection of skin cancer yields a ten year survival rate of 94%. However, this survival rate drops drastically as the cancer progresses and reaches the next stages. Ten year survival rates come to a meagre 15% in the case of Melanoma, when it is detected in the final stage [5]. **Prostatic Adenocarcinoma** (PCa) is the most diagnosed form of cancer and the second leading cause of cancer-specific death in men. An adenocarcinoma is a type of cancer that arises in the cells of glands. Most cells in the prostate gland are of the glandular type, which means that adenocarcinoma is the most common type of cancer to occur in the prostate. Cancer occurs when the genes of a cell become abnormal (mutation), causing the cell to multiply and interfere with the normal function of a tissue.https://www.myvmc.com/diseases/prostate-cancer-adenocarcinoma-of-the-prostate. **Lung** cancer is the number one cause of cancer deaths in both men and women in worldwide. The two types of lung cancer, which grow and spread differently, are small cell lung cancers (SCLC) and non-small cell lung cancers (NSCLC).The stage of lung cancer refers to the extent to which the cancer has spread in the body. Smoking cessation is the most important measure that can prevent the development of lung cancer. *https://www.medicinenet.com/lung_cancer/article.htm#lung_cancer_facts*

Bladder cancer begins when healthy cells in the bladder lining, most commonly urothelial cells, change and grow out of control, forming a mass called a tumor. Urothelial cells also line the renal pelvis and ureters. Although cancer that develops in the renal pelvis and ureters is considered a type of kidney cancer, it is treated in the same way as bladder cancer and is described in this guide. A tumor can be cancerous or benign. A cancerous tumor is malignant, meaning it can grow and spread to other parts of the body. A benign tumor means the tumor can grow but will not spread. Benign bladder tumors are rare. *https://www.cancer.net*

Oral and Oropharyngeal Cancers of the oral cavity is the ninth most common cancer among men. Rates of these cancers are more than twice as high in men as in women. The average age of diagnosis is 62. Different factors cause different types of cancer. Researchers continue to look into what factors cause this type of cancer. Although there is no proven way to completely prevent this disease. Several of the risk factors for oral and oropharyngeal cancer can be avoided by making healthy lifestyle choices. Stopping the use of all tobacco products is the most important thing a person can do to reduce the risk of oral and oropharyngeal cancer, even for people who have been using tobacco for many years. Reducing your risk of HPV infection is also important. The HPV vaccine can prevent HPV-related cancers.

Kidney cancer begins when healthy cells in 1 or both kidneys change and grow out of control, forming a mass called a renal cortical tumor. A tumor can be malignant, indolent, or benign. A malignant tumor is cancerous, meaning it can grow and spread to other parts of the body. An indolent tumor is also cancerous, but this type of tumor rarely spreads to other parts of the body. A benign tumor means the tumor can grow but will not spread. **Thyroid** cancer begins in the thyroid gland. This gland is located in the front of the neck just below the larynx, which is called the voice box. It is common for people with thyroid cancer to have few or no symptoms. Thyroid cancers are often diagnosed by routine examination of the neck or are unintentionally found by x-rays or other imaging scans that were performed for other reasons.

III. CNACER CAUSES

Cancer refers to any one of a large number of diseases characterized by the development of abnormal cells that divide uncontrollably and have the ability to infiltrate and destroy normal body tissue. Cancer often has the ability to spread throughout your body. Cancer is caused by changes (mutations) to the DNA within cells. The DNA inside a cell is packaged into a large number of individual genes, each of which contains a set of instructions telling the cell what functions to perform, as well as how to grow and divide. Errors in the instructions can cause the cell to stop its normal function and may allow a cell to become cancerous.

A. Gene Mutations

A gene mutation can instruct a healthy cell to:

Allow rapid growth--A gene mutation can tell a cell to grow and divide more rapidly. This creates many new cells that all have that same mutation.

Fail to stop uncontrolled cell growth-- Normal cells know when to stop growing so that you have just the right number of each type of cell. Cancer cells lose the controls (tumor suppressor genes) that tell them when to stop growing. A mutation in a tumor suppressor gene allows cancer cells to continue growing and accumulating.

Make mistakes when repairing DNA errors--DNA repair genes look for errors in a cell's DNA and make corrections. A mutation in a DNA repair gene may mean that other errors aren't corrected, leading cells to become cancerous.

B. Causes of Gene Mutations

Gene mutation can occur for several reasons, for instance:

Gene mutations by birth--One may be born with a genetic mutation that you inherited from your parents. This type of mutation accounts for a small percentage of cancers. **Gene mutations that occur after birth--**Most gene mutations occur after birth isn’t inherited. A number of forces can cause gene mutations, such as smoking, radiation, viruses, cancer-causing chemicals (carcinogens), obesity, hormones, chronic inflammation and a lack of exercise.

Gene mutations occur frequently during normal cell growth. However, cells contain a mechanism that recognizes when a mistake occurs and repairs the mistake. Occasionally, a mistake is missed. This could cause a cell to become cancerous.

C.Risk Factors

Factors known to increase the risk of cancer include:

Age--Cancer can take decades to develop. That's why most people diagnosed with cancer are 65 or older. While it's more common in older adults, cancer isn't exclusively an adult disease — cancer can be diagnosed at any age.

Habits--Certain lifestyle choices are known to increase your risk of cancer. Smoking, drinking more than one alcoholic drink a day (for women of all ages and men older than age 65) or two drinks a day (for men age 65 and younger), excessive exposure to the sun or frequent blistering sunburns, being obese, and having unsafe sex can contribute to cancer. You can change these habits to lower your risk of cancer — though some habits are easier to change than others.

Family history--Only a small portion of cancers are due to an inherited condition. If cancer is common in your family, it's possible that mutations are being passed from one generation to the next. You might be a candidate for genetic testing to see whether you have inherited mutations that might increase your risk of certain cancers. Keep in mind that having an inherited genetic mutation doesn't necessarily mean you'll get cancer.

Health conditions--Some chronic health conditions, such as ulcerative colitis, can markedly increase your risk of developing certain cancers. Talk to your doctor about your risk.

Environment--The environment around you may contain harmful chemicals that can increase your risk of cancer. Even if you don't smoke, you might inhale secondhand smoke if you go where people are smoking or if you live with someone who smokes. Chemicals in your home or workplace, such as asbestos and benzene, also are associated with an increased risk of cancer. *https://www.mayoclinic.org/diseases-conditions/cancer/symptoms-causes/syc-20370588*

IV. CANCER DETECTION TECHNIQUES

Early cancerization tissue detection has important clinical significance. According to clinical data, more than 85% of cancers originate in the epithelium that lines the internal surfaces of organs throughout the body; thus, it necessitates the availability of suitable detection methods and apparatuses that can effectively probe these lesions either outside or by being inserted into the human body. The accurate detection of cancer is a challenging task. According to the Centers of Disease Control and Prevention (CDC), breast cancer is the most prevalent cancer in women and in 2013 accounted for 230,815 women and 2,109 men being diagnosed with breast cancer [6].The following works carried out by different authors explains different cancer detection techniques.

John shell , and william d. Gregory[7] has suggested an article on the positive neural network implementation which is used to improve the skin cancer detection accuracy by using the back propagation neural networks(BNN). The implementation has done by using Math Works Matlab software which is augmented with modified regression algorithms. The neural networks based mathematical implementation includes the breast, squamous and basal cell carcinoma. It also has the potential to be utilized intra operatively providing an oncologist or surgeon with valuable tissue assessment information.

Md. Delwar Hossain and Ananda Sanagavarapu Mohan[8] has an application for high dense breast cancer detection. Coherent focusing for time-reversal (TR) microwave imaging in beam space for the detection and localization of multiple tumors in highly dense 3-D breast phantoms. They also proposed a novel coherent beam space time reversal maximum likelihood (C-B-TR-ML) technique to obtain accurate tumor locations with reduced computational burden. **T**he superior capabilities of the proposed C-BTR- ML microwave-imaging technique in detecting and localizing multiple tumors embedded inside highly dense breast phantoms. The coherent beam space approach has been extended to TR-MUSIC algorithm and Decomposition of the time reversal operator (DTRO) algorithm. Finally they demonstrated that all the three proposed imaging techniques offer robust performance in highly dense breasts. In particular, it has been verified that the proposed CB- TR-ML technique performs better than C-B-TR-MUSIC and C-B-DORT for accurately resolving multiple tumors in highly dense breast phantoms.

Yifan Fu and Zhiwen Huang[9] has aimed to provide a prototype called, a miniature flexible 3 × 3 Mueller matrix endoscopy and preliminarily verify its effectiveness on cancer detection. They said that detecting the lesions at a pre invasive stage by existing imaging techniques, such as computed tomography, magnetic resonance imaging (MRI), ultrasound, and traditional endoscope is difficult. Hence they created a 3 × 3 Mueller matrix structure with distal tip polarization modulation and applied it to a flexible endoscope. For that they use mini servomotor and polarizer to realize the PSG (polarization state generator) and PSA (polarization state analyzer) structures in distal tip. Thus the proposed Mueller matrix and its extracted parameters can distinguish tumor position from normal skin even though the tumor occurs under the skin tissues.

Sepideh Rahmatinia and Babak Fahimi[10] has suggested the two major approaches for breast cancer detection. That is, combination of EM excitation and thermal monitoring. The reason for combining these two approaches is to obtain maximum benefit of each method while reducing the health risk for patients. They modeled a Homogeneous and heterogeneous breasts tissues excited with different types of radio frequency sources, and thermal analysis is performed by considering human metabolism. Moreover, they distributed the temperature and SAR, possibly to pinpoint the size and location of the cancerous tumors. Finally they concluded that, this method can be utilized to design a wearable device that can be used anytime and anywhere to collect temperature and signals of breast tissue and analyze the data to estimate the possibility of breast cancer.

Mario R. Casu, Marco Vacca[12] have stated that Microwave Imaging (MI) for breast cancer detection is being considered as a diagnostic tool that can complement methods like mammography and magnetic resonance imaging (MRI). This is because MI offers a different perspective of the breast, being sensitive to the dielectric contrast between the normal and diseased tissues rather than the density. Tumor tissues are characterized by a higher dielectric constant than healthy tissues [11]. The author here proposed two main approaches for MI that is, Ultra Wide-Band (UWB) Radar and Tomography. He also presented and concluded a low-cost, fast, and accurate system named imaging algorithm of Interferometric- MUltiple SIgnal Classification (I-MUSIC) for breast cancer detection using microwave imaging. The system is low-cost because it uses components off-the-shelf and in-house fabricated antennas. It is fast because it executes the imaging algorithm more than 20x faster than a multicore CPU.

Danh Cong Nguyen and Farhad Azadivar[13] developed a cancer detection technique based on genetic Algorithm. They used genetic-algorithm-based mathematical approach to detect hepatocellular cancer before it is actually developed. They stated that many tumor and non tumor cells share the same cancer causing genes. However, their transformations are regulated by different gene regulatory network GRNs. By understanding these GRNs and altering some of them, it is possible to detect the potential for cancer and to prevent cells from evolving into a cancerous status. They developed Probabilistic Boolean networks (PBNs) model for a sample of tumor and non tumor cells from microarray data. After estimation of the corresponding GRNs through regression analysis and estimation of their long term behavior by simulation, a genetic algorithm- based simulation optimization process was used to determine the particular rules within the GRN to be altered and the replacement rules to be implemented. They provide a new way of utilizing mathematics and optimization in preventing cancer. However, they are purely mathematical and are not supported by any clinical experimentation.

Hao Wu1 et al, [14] have constructed a gene network based method, to identify dysregulated pathways in glioblastoma cancer, by using the interrelationship between gene mutations and expression data. They also used CFinder clustering algorithm to identify cliques in the constructed gene network. Their research in this area provides a useful complement to the correlation between gene mutations and gene expression in cancer. This enriches the users to understand the molecular pathogenesis of cancer. They have concluded that the network also provides a supplement to the analyses of cancer data and a useful basis for dysregulated pathways detection.

Segmenting head and neck organs using CT images were facing higher risk factors like low contrast of soft tissue and image artifact. For this Shape priors are proved effective to address this task. But the shape prior method also suffers from shape variation. So, Zhensong Wang , Lifang Wei et al, [15] performed a study and proposed a noval method to incorporate shape priors into a hierarchical learning-based model. They overcome the drawbacks of the conventional shape-based segmentation methods by using joint shape and appearance learning, hierarchical vertex regression model and hierarchical critical model vertex identification method. By using these methods they solved the drawback of sensitivity to shape initialization in the conventional deformable models.

Metric Shadab Khan, ∗Aditya Mahara, et al [16] have stated that Prostatic adenocarcinoma (PCa) is the most diagnosed form of cancer and the second leading cause of cancer-specific death in men. The recurrences in prostate cancer are often predicted by assessing the status of surgical margins (SM) – positive surgical margins (PSM) increase the chances of biochemical recurrence by 2-4 times. The authors in this paper trained a classifier using composite impedance metrics (CIM) data which is used to classify tissue as benign or cancerous. By using this CIM data they presented a (EIA) electrical impedance acquisition system which sense differences in electrical properties between the benign and malignant tissues within the prostate which also differentiates the apex, base, and lateral surface tissues in PCa. So they concluded that CIMs were found to be an effective tool to distinguish benign from the cancerous tissues.

V. SEGMENTATION BASED CANCER DETECTION TECHNIQUES

In computer vision, segmentation refers to the process of partitioning a digital image into multiple segments (sets of pixels, also known as super pixels).Image segmentation is typically used to locate objects and boundaries (lines, curves, etc.) in images. More precisely, image segmentation is the process of assigning a label to every pixel in an image such that pixels with the same label share certain visual characteristics. The result of image segmentation is a set of segments that collectively cover the entire image, or a set of contours extracted from the image. Each of the pixels in a region is similar with respect to some characteristic or computed property, such as color, intensity, texture All image processing operations generally aim at a better recognition of objects of interest, i.e., at finding suitable local features that can be distinguished from other objects and from the background. The next step is to check each individual pixel to see whether it belongs to an object of interest or not. This operation is called segmentation and produces a binary image. A pixel has the value one if it belongs to the object otherwise it is zero. After segmentation, it is known that which pixel belongs to which object. The following works carried out by different authors explains segmentation based cancer detection techniques.

Madhuri Avula, et al [17] has examined a model for segmenting the bone cancer which has no anticipation in future. Most of the study is done by using data mining methods and the image processing techniques for medical image analysis process. Rule mining, supports vector machines, fuzzy theory and probabilistic neural networks and learning vector quantization are the mostly used methods for detection and segmentation of bone cancer. The author in this paper used *k* means clustering algorithm for bone image segmentation. The segmented image is further processed for bone cancer detection by evaluating the mean intensity identified area. They also used the extracted segmented image to further process and evaluate the mean pixel intensity in the region of interest. Based on the mean pixel intensity value, they achieved the bone cancer detection accurately.

Rajyalakshmi. Ua and Satya Prasad Ka [18] have proposed a method known Modified - Marker Controlled Watershed Approach (MMCWA) which is used to segment the pre-processed Hematoxylin and Eosin stained breast cancer histopathological images. Also, they obtained the nuclei location by using the Hough transform. In segmentation, The Small fixed Structuring Element (SE) size removes the respective bright and dark details during opening and closing morphology, so the authors in this paper used the structuring element (SE) to remove the huge contour details of the input image. Finally they developed an integrated module using Circular Hough Transform (CHT) for cell nuclei detection and morphological SE map modified MCWA segmentation method for nuclei extraction.

Aswin.R.B, et al [19] has examined a method for the diagnosis of skin cancer which involves no direct contact with skin. They just used the images to diagnose the cancer part so that they applied certain image processing technique which is subjected to segmentation. The authors performed here is Otsu Color Threshold Segmentation which uses the thresholding principle. In this method they automatically perform the histogram shape-based image thresholding which shows two different pixel intensities for the lesion and healthy skin. Finally they segmented the lesions by using IMAGE J software. Since this system has no physical contact with skin, they said it is not painful like biopsy method.

Hady Ahmady Phoulady, et al [20] has generated a new segmentation method replacing the Otsu method [19]. Instead of using four segmentors to differentiate the nucleus area of the cell from the background, they proposed a new ensemble approach to remove some blobs (segmented nuclei) based on their size and concavity or the whole image segmentation. So that they can form a single segmentation method which has a higher separability measure than all individual original segmentations. The process of creating the four segmentations took more than 80% of the computation time for them. But the proposed approach that is, small blob removal and checking the size of the largest blobs took only less than 5% where the rest was spent generating the ensemble segmentation and accessing and saving the data.

Kyoung-Mi Lee and W. Nick Street [21] have constructed a method for automated detection and segmentation of breast cancer using neural network. Where, the authors made the network to learn the cluster shapes and to classify the nuclei. This proposed neural network grows incrementally by creating a new cluster whenever an unseen cluster shape is presented. The hidden nodes in each cluster provide faster and more accurate nuclei detection and segmentation.The centers and widths of the hidden nodes provide a guideline for an intelligent search through the space of possible nuclei. Thus the improvement in segmentation is achieved by generating a high quality initial outlines with the classes of objects.

Ning Situ, et al, [22] has proposed an algorithm for malignant melanoma segmentation. They used two imaging modalities such as Cross-polarization Epiluminescence Microscopy (XLM) and Transillumination Epiluminescence Microscopy (TLM). The algorithm named evolutionary strategy (ES) based segmentation algorithm is used to identify the lesion area by an ellipse. The previous methods for segmentation all have their own limitations when dealing with skin lesion images. To improve the performance and the robustness of the system, the authors developed an ES-based segmentation algorithm because of its distinct characteristics. It can identify the very smaller region in skin lesions than the previous algorithms Another advantage of this algorithm is it does not require any user input parameters, in skin lesion segmentation.

Bram van Ginneken, et al, [23] has represented a scheme called refined segmentation-by-registration scheme. Where, the segmentation of the pathological lungs is refined by applying voxel classification. The authors introduce the refinement step to improve the segmentation accuracy compared to a standard segmentation-by-registration approach. The authors also compared the proposed registration scheme with existing two other fully automatic algorithms. The proposed refined segmentation-by-registration scheme performs well on scans with up to a quarter of the lung volume affected high density pathology.

Telagarapu Prabhakar, et al, [24] has overcome the disadvantages of mammography by using the ultrasound imaging technique for segmentation. This paper focuses on developing an algorithm for an automatic segmentation of breast lesions from ultrasound images. The author in this paper reduces the speckle noise using Tetrolet filter. By this, the breast lesions were automatically segmented by using statistical feature based active contour method. In this method the seed points are identified automatically from the image using statistical features.

Sholpan Kauanova, et al [25] has presented the approach for automated segmentation in DIC images. The segmentation has done in clustered cells using G neighbor smoothing approach. This approach is followed by Kauwahara filtering and local standard deviation approach for boundary detection. For the ground truth data set NIH/FIJI image J tools are used for analysis. In this approach the authors felt that detection of cell boundaries using segmentation approach even in the case of realistic measurement conditions is a challenging problem. But finally they achieved the results by using adaptive filtering and binarization where they reached a high level of accuracy in all of the images.

Han Sang Lee, et al [26] has constructed method for automated segmentation in CT images by using texture and context feature classification. Here the segmentation process were done in SRM that is Small renal mass in CT images. For that they determined the kidney ROI first by using intensity and location thresholding. And then false positive reduction is applied with patch-based texture and context feature classification. Finally the segmentation process is done by using the above result values as a seed, with region growing, active contours, and outlier removal with size and shape criteria. The average sensitivity, average specificity, and average DSC of the segmentation is 89.91%, 98.96%, and 88.94%, respectively.

VI. CONCLUSION

This paper presents an overview of different types of cancer and cancer causing agents and different risk factors which can increase the risk of cancer. This paper also discusses the various cancer detection techniques and segmentation based cancer detection techniques to detect cancer in early stages which can save human life. Thus cancer detection techniques prove to be a promising technology in healthcare industry.

REFERENCES

[1] T. Rastogi, A. Hildesheim, and R. Sinha, "Opportunities for cancer epidemiology in developing countries", IEEE Transaction, vol. 53, no. 6, june 2017.

[2] Sunny Y. Auyang *"*Magneto-thermal modeling of biological tissues: a step toward breast cancer detection,*ieeencer*, 4: 909-917 (2004). World health organization, world cancer report.

[3] Worldwide breast cancer. [online]. Available: www.worldwidebreastcancer.com, accessed on: jan. 25, 2017.

[4] V. V. Lao, W. M. Grady, "Epigenetics and Colorectal cancer", nature reviews gastroenterology and hepatology, vol. 8, no. 12, pp. 686–700, 2011.

[5] Andre Esteva, Brett Krupel, Sebastian thrun, "Deep networks for early stage skin disease and skin cancer classification", stanford university, 2015.

[6] U.S. Cancer statistics working group. ``united states cancer statistics: 1999-2013 incidence and mortality web-based report.'' Dept. healths hum. Services, centers disease control prevention, nat. cancer inst., atlanta, ga, usa, tech. rep., [online]. available: http://www. cdc.gov/uscs ,2016.

[7] John shell ,william d. gregory, "Efficient cancer detection using multiple neural networks aurora sinai medical center", novascan inc., milwaukee, wi 53233.

[8] M.D. Delwar Hossain, Ananda Sanagavarapu Mohan*, "*Cancer detection in highly dense breasts using coherently focused time-reversal microwave imaging", 2014.

[9] yifan fu, zhiwen huang, honghui he, hui ma, and jian wu. “Flexible 3 × 3 Mueller matrix endoscope prototype for cancer detection”,2012.
[10] Sepideh Rahmatinia, Babak fahimi, “Magneto-thermal modeling of biological tissues: a step toward breast cancer detection”, ieee transactions on magnetics, vol. 53, no. 6, june 2017.
[11] P. M. Meaney, M.W. Fanning, D. Li, S. P. Poplack, K.D. Paulsen, “A clinical prototype for active microwave imaging of the breast,” *ieee* trans. microw. theory tech., vol. 48, no. 11, pp. 1841–1853, nov. 2000.
[12] D.Mario, R. Casu, Marco Vacca, Jorge et.al., *“*A cots-based microwave imaging system for breast-cancer detection”, ieee transactions on biomedical circuits and systems, vol. 11, no. 4, August 2017.
[13] Danh Cong Nguyen, Farhad Azadivar, “Application of computer simulation and genetic algorithms to gene interactive rulesfor early detection and prevention of cancer”, Ieee systems journal, vol. 8, no. 3, september 2014.
[14] Hao Wu1 , Jihua Dong, Jicheng Wei1 “Network-based method for detecting dysregulated pathways in glioblastoma cancer” ISSN 1751-8849.
[15] Zhensong Wang , Lifang Wei, Li Wang, Yaozong Gao, Wufan Chen,”Hierarchical vertex regression-based segmentation of head and neck CT images for radiotherapy planning”, Ieee transactions on image processing, vol. 27, no. 2, February 2018.
[16] Shadab Khan, Aditya Mahara, Elias S. Hyams, Alan, R. Schned, “Ryan halter, prostate cancer detection using composite impedance metric”,ieee transactions on medical imaging, vol. 35, no. 12, december 2016.
[17] Madhuri Avula, Narasimha Prasad Lakkakula, Murali Prasad Raja, “Bone cancer detection from mri scan imagery using mean pixel intensity”, 8th Asia Modelling Symposium, 2014.
[18] Rajyalakshmi, Koteswara Rao, Satya Prasad, “Supervised classification of breast cancer malignancy using integrated modified marker controlled watershed approach”, Ieee 7th international advance computing conference, 2017.
[19] R.B Aswin., J. Abdul Jaleel, Sibi Salim, *“*Hybrid Genetic algorithm - artificial neural network classifier for skin cancer detection”, *ieee, 2014.*
[20] Hady Ahmady Phoulady, Baishali Chaudhury, Dmitry Goldgof, Lawrence O. Hall1, “Experiments with large ensembles for segmentation and classification of cervical cancer biopsy images”, ieee,2014.
[21] kyoung-mi lee, W. Nick street, “An adaptive resource-allocating network for automated detection, segmentation, and classification of breast cancer nuclei topic area: image processing and recognition”, Ieee transactions on neural networks, vol. 14, May 2003.
[22] Ning situ, Xaojing yuan, George Zouridakis, Nizar Mullani, “Automatic segmentation of skin lesion images using evolutionary strategy”, Ieee, 2007.
[23] Ingrid Sluimer, Mathias Prokop, Bram Van Ginneken, “Automated segmentation of the pathological lung cancer”, Ieee transactions on medical imaging, vol. 24, no. 8, August 2005.
[24]Telagarapu Prabhakar, S.Poonguzhali, “Biomedical Engineering international conference (bmeicon-2017) automatic detection and classification of benign and malignant lesions in breast ultrasound images using texture morphological and fractal features”, ieee,2017.
[25] Sholpan kauanova, Ivan Vorobjev, Alex Pappachen James, “Automated image segmentation for detecting cell spreading for metastasizing assessments of cancer development”, Ieee, 2017.
[26] Han Sang Lee1, Helen Hong, Junmo kim, “Detection and segmentation of small renal masses in contrastenhanced CT images using texture and context feature classification”, ieee, 2017.