

*Review Article***CLASSIFICATION OF THERMOGRAPHIC IMAGES FOR BREAST CANCER DETECTION USING NEURAL NETWORK**Priti Jumamkar¹Abhay Kasetwar²

¹PG Student, Department of Electronics and Telecommunication Engineering, S B Jain Institute of Technology, Management & Research, Kalmeshwar Road, Nagpur, Maharashtra 441501.

²Professor, Department of Electronics and Telecommunication Engineering, S B Jain Institute of Technology, Management & Research, Kalmeshwar Road, Nagpur, Maharashtra 441501.

Abstract:

Growing a breast cancer screening method is very important to facilitate early breast cancer detection and treatment. Several technologies contributed to the reduction in rate of mortality from this sickness, however early detection contributes maximum to stopping disorder spread, breast amputation and loss of life. Thermography is an effective tool to cancer screening approach can discover tumors at an early degree even underneath precancerous situations via looking at temperature distribution in each breast. The thermograms is perfect screening and has low cost than other varieties of screening techniques like the mammogram, ultrasound, and magnetic resonance imaging relying on a temperature of breast and surrounding place via the usage of a unique warmth-sensing camera to determine the warmth within the area of breasts.

The thermograms obtained on thermography can be interpreted with the use of deep learning models which include convolution neural networks (CNN). CNN can classify breast thermograms into categories including ordinary and peculiar. In this take a look at, we aimed to summarize the modern work and development in breast cancers detection based totally on thermography and CNNs. We perform more studies associated with the implementation of deep neural networks for breast thermograms classification and suggest destiny studies directions for developing representative datasets, feeding the segmented image. This paper provides a comparative study of several breast cancer detection techniques using neural network and deep learning models.

Key words: Thermograms, Convolution Neural Network (CNN), Breast Cancer.

Introduction

Breast cancer is a type of cancer that starts in the breast. Cancer starts when cells begin to grow out of control. Cancers are a class of disease that starts growing inside the cells, the building blocks of our body. In recent years, the occurrence rate of breast cancer has increased. It involves odd and uncontrollable cellular growth that has the ability to disturb different parts of the human body. It can occur in both male and female, relying on the form of cancer. According to statistics of Indian Cancer Society in projected incidence of patient with cancer in India among males was 679,421 (94.1 per 100,000) and among females 712,758 (103.6 per 100,000) for the year 2020. One in 68 males (lung Cancer), 1 in 29 females (breast cancer) (1). One of the common forms of cancer present in the world is breast cancers. It is common and deadly forms of cancers. Most of the instances, women are cause with breast cancer. (2)

The breast cancers survival has also grown during the last few years; with the development of more effective diagnostic tools and remedy methodologies. The low survival rates in much less evolved countries can be because of a loss of early detection methodologies; therefore, a huge number of cases are detected in past due-stage.

Where breast Cancer starts

Breast cancers can start from different parts of the breast

- Breast cancers begin in the ducts that carry milk to the nipple (ductal cancers)
- Some start in the glands that make breast milk (lobular cancers)
- There are also others types of breast cancer that are less common like phyllodes tumor and angiosarcoma.
- A small number of cancers start in other tissues in the breast. These cancers are called sarcomas and lymphomas and are not really thought of as breast cancers.

There are many techniques available to detect the presence of cancer: ultrasound, thermography, magnetic resonance imaging (MRI), microwave, X-ray, etc.

This study is organized as follows. Section 1 presents a review of the available breast cancer screening methods. Section 2 explains the concepts involved in breast thermal imaging and its potential for breast cancer detection.

1. Standard Screening Methods

The evaluation of screening modalities, in particular in the network placing, methodological medical and moral reasons. Randomized clinical trials are considered the gold widespread for evaluating a new screening test. The lengthy-term breast cancer mortality rate of ladies randomized to acquire a brand new screening take a look at is as compared with that of women randomized to get

hold of fashionable care. However, such trials are difficult to behavior. They require tens of heaps of Ladies who need to be observed up for extra than 15 years. Moreover, due to the fact mammography screening has been proven to be powerful in a few trials, it'd in all likelihood be even greater hard to demonstrate any additional efficacy of latest checks. Subsequently, as remedy. (3)

For breast cancers have advanced over time, the effect of screening on breast cancer mortality can be more and more hard to establish. Due to those demanding situations, new screening tests are frequently first studied via organizing characteristics of the assessments themselves, as opposed to by using analyzing their impact on patient final results which includes breast cancers mortality. Vital check traits include sensitivity, specificity, safety, value, simplicity, and patient and clinician acceptability.

2. Breast Thermal Imaging Modality

Infrared waves are inside the wavelength variety of light and microwaves. All objects can emit infrared radiation as a function of the temperature of that item. Heating an item will increase the quantity of infrared radiation launched and causes it to propagate in shorter waves (4). In medical infrared imaging, this range is referred to as thermal Infrared (IR). Inside this variety, infrared emission normally happens as warmth or thermal radiation, the size of which is called thermography. The image produced by way of IR imaging Is known as a thermograms (5).

Cancer Detection and Classification

Method

Detecting cancer within the breast and classifying it to regular and peculiar instances The use of thermography image approach is first off converting rgb thermal photo To grayscale. The modern methods consist of 5 principal steps of image Acquisition, photo preprocessing and segmentation, extract features, and finally Classify photograph to a normal or abnormal case.

The principle concept for preprocessing relying on converting rgb scale mode to Grayscale mode, lab mode or hsv mode. The primary concept for segmentation step is right, and left breasts separated from a thermal photo which also includes the History, palms, and neck after changing to grayscale. There may be extra than a Technique used for segmentation together with location-primarily based, threshold-based, and area based Strategies.

Feature extraction used when there was uneven in warmth detected for breast Tissues of ladies body. Feature extraction kinds are statistical capabilities like Mean, median, standard deviation, minimum and maximum temperature values Advocated whilst there may be an asymmetry between quadrants of the breast.

Histogram-based totally features which includes mean, variance, skewness and kurtosis which Extracted whilst proper and left breasts have asymmetry and gray degree co-occurrence Capabilities and gray level run-duration features

which used to classify everyday and strange instances. Then after segmentation the use of grey-level co-occurrence matrix (glcm) which used to calculate this texture capabilities entropy, electricity, a distinction of variance and assessment.

Literature Survey

Dayakshini Sathish; Surekha Kamath,(2) in this article, a study of various clinical imaging modalities and survey of computer aided detection (cad) techniques used for the detection of breast cancers are offered. Early breast cancer detection, is essential as it could increase the rate of analysis, cure and survival of the affected ladies. Clinical imaging techniques can hit upon early signs of breast cancer. They are extensively utilized to diagnose, stage breast cancers and manual treatments. Additionally a number of contemporary imaging strategies are discussed here. Comparative study of mammography, ultrasound, thermography and magnetic resonance imaging describes the advantages of thermography in early detection of breast cancer. Cad offers a fast, reliable, and price-effective second opinion to support docs with the diagnostic control of breast cancers. These article evaluations numerous cad algorithms advanced and studied for mammography, ultrasound and thermography. From the literature review, it's far discovered that accuracy of detection of breast abnormalities using cad are decided by many elements, including size of database, picture

satisfactory, segmentation of vicinity of interest, extracted functions and classifiers used, etc.

B. F. Jones, (3) examine the Infrared thermal imaging of the skin has been used for numerous a long time to screen the temperature distribution of human skin. Abnormalities along with malignancies, inflammation, and contamination motive localized will increase in temperature which shows as warm spots or as asymmetrical styles in infrared thermograms. Although it is nonspecific, infrared thermology is a powerful detector of problems that affect a affected person's body structure. Whilst using infrared imaging is growing in lots of business and security applications, it has declined in remedy in all likelihood due to the continued reliance on first era cameras. The transfer of navy technology for scientific use has brought on this reappraisal of infrared thermology in medicinal drug. Virtual infrared cameras have a good deal progressed spatial and thermal resolutions, and libraries of photo processing exercises are to be had to investigate photos captured each statically and dynamically. If thermographs are captured under managed conditions, they may be interpreted with ease to diagnose positive conditions and to display the response of a patient's physiology to thermal and different stresses. Some of the main regions where infrared thermography is being used efficiently are neurology, vascular disorders, rheumatic diseases,

tissue viability, oncology (specifically breast cancer), dermatological disorders, neonatal, ophthalmology, and surgical procedure.

D. Kenndy, Tanya M. Lee, (4) evaluated that breast cancers are the regularly diagnosed cancers of ladies in North America. In spite of advances in remedy which have decreased mortality, breast cancer stays the second main reason of cancer brought on death. Numerous properly set up equipment are used to screen for breast cancers together with clinical breast exams, mammograms, and ultrasound. Thermography become first added as a screening device in 1956 and turned into first of all well general. No single tool offers notable predictability; however, an aggregate that includes thermography can also raise both sensitivity and specificity. In light of technological advances and maturation of the thermographic industry, extra research is required to affirm the capacity of this era to offer a powerful non-invasive, low danger adjunctive device for the early detection of breast cancer.

Hesham Arafat Ali, Shaimaa Mohammed, (5) This paper focuses on reviewing the cutting-edge techniques and techniques of detecting and classifying the breast cancers using thermography photos. Cancer is taken into consideration as the leading reason of demise amongst people. The cancer is generated from uncontrolled boom for cells to acquire them together to assemble tumor. Such a cancers types is breast cancers. Detecting breast

cancers, which is the second one main motive of loss of life in ladies after lung cancer, depends on asymmetry in temperature between breasts. If breast cancers may be detected at an early level, it could store girls life. The thermograms is greater proper screening and has decrease price than other varieties of screening methods like the mammogram, ultrasound, and magnetic resonance imaging depending on a temperature of breast and surrounding area by using a unique heat-sensing camera to determine the heat in the location of breasts. To classify wholesome and dangerous cases of breast cancer, methods are divided into image acquisition, preprocessing, segmentation, feature extraction and category.

Dr.Shweta Agrawal, Dr.Parag Goyal, (6) investigated the various photo processing strategies are used to research the histopathological photos for diagnosing the cancers. Guide detection of those cells may be very time eating and the end result will rely upon the experience of the pathologist. So computer aided techniques are used for fast processing and accurate end result of the diagnosis. The deep getting to know version makes use of the convolutional neural network (cnn) that routinely extracts the capabilities and classify the photo the use of completely connected community. In this paper, we've trained a sequential convolutional neural network and obtained the best prediction accuracy for detection of breast cancers 99.91%.

Meha Desai, Manan Shah, (2021), (9) This paper

aims to review Artificial neural networks, Multi-Layer Perception Neural network (MLP) and Convolutional Neural network (CNN) employed to detect breast malignancies for early diagnosis of breast cancer based on their accuracy in order to identify which method is better for the diagnosis of breast cell malignancies. Deep comparison of functioning of each network and its designing is performed and then analysis is done based on the accuracy of diagnosis and classification of breast malignancy by the network to decide which network outperforms the other. CNN is found to give slightly higher accuracy than MLP for diagnosis and detection of breast cancer. There still is the need to carefully analyze and perform a thorough research that uses both these methods on the same data set under same conditions in order identify the architecture that gives better accuracy.

Conclusion

Early detection of breast cancers stays the cornerstone of breast cancer control. Breast self-exam is usually recommended by way of the arena health employer to elevate women recognition of breast cancers dangers. Thermography has been proposed as an early detection screening method, and we accept as true with that it presents a promising development towards a self-screening method that can locate breast cancer at an early level. A top level view of breast thermograms ability

suggests that the early signs and symptoms of breast cancer may be located by way of figuring out the asymmetrical thermal distributions between the breasts. The asymmetrical thermal distribution on breast thermograms can be evaluated the usage of laptop-assisted generation.

The usage of this technology can limit mistakes. Our assessment has shown that the present day cnn fashions have brought about an improved in accuracy of breast cancer thermograms category, especially in distinguishing among wholesome and cancerous instances. Although, the overall performance of the cnn version should be advanced. Destiny research desires to work toward improved type of breast thermograms. This will require supplying consultant datasets, preparing good,, assigning proper kernels, implementing light-weight cnn models. Fulfillment of those goals will shorten the time concerned in convolution computation and boom accuracy costs. A threat free screening technique the usage of thermography could then be proposed for self-breast screening method at an early level without requiring physical involvement.

References

1. Prashant Mathur, Krishna Sathishkumar, Cancer Statistics, 2020: Report From National Cancer Registry Programme, India., An American Society of Clinical Oncology Journal, volume 6,2020.

2. Dayakshini Sathish; Surekha Kamath; K.V. Rajagopal; Keerthana Prasad, International Journal of Medical Engineering and Informatics (IJMEI), Vol. 8, No. 3, 2016.
3. B. F. Jones, "A reappraisal of the use of infrared thermal image analysis in medicine," IEEE Trans. Med. Image., vol. 17, no. 6, pp. 1019_1027, dec 1998.
4. Joann G. Elmore, Katrina Armstrong, Constance D. Lehman, Suzanne W. Fletcher. Screening for Breast Cancer, American Medical Association, Vol 293, No 10 march 9, 2015.
5. Hesham Arafat Ali, Shaimaa Mohammed Breast Cancer Detection and Classification Using Thermography, www.researchgate.net 9 April 2018.
6. Dr.Shweta Agrawal, Dr.Parag Goyal, Sequential Convolutional Neural Network for Automatic Breast cancer image classification using Histopathological Images. 2018.
7. Gade and T. B. Moeslund, "Thermal cameras and applications: A survey," Mach. Vis. Appl., vol. 25, no. 1, pp. 245_262, Jan. 2014.
8. D. Kennedy, Tanya M. Lee, A Comparative Review of Thermograph as a Breast Cancer Screening Technique, journal of medical science semanticsholar.org, 2009.
9. Meha Desai, Manan Shah, An anatomization on breast cancer detection and diagnosis employing multi-layer perception neural network and convolutional neural network (CNN), 2021.
10. Ali Montazeri, Health-related quality of life in breast cancer patients: Journal of Experimental & Clinical Cancer Research.
11. Chunekar VN, Ambulgekar HP. Approach of Neural Network to Diagnose Breast Cancer on three different Data Set International Conference on Advances in Recent Technologies in Communication and Computing, 2009.
12. Kim, Y.A.; Oh, I.H.; Yoon, S.J.; Kim, H.J.; Seo, H.Y.; Kim, E.J.; Lee, Y.H.; Jung, J.H. The Economic Burden of Breast Cancer in Korea from 2007.
13. Cireşan DC, Giusti A, Gambardella LM, Schmidhuber J. Mitosis Detection in Breast Cancer Histology Images with Deep Neural Networks. Lect Notes Comput Sci. 2013.
14. Dabeer S, Khan MM, Islam S. Cancer diagnosis in histopathological image: CNN based approach. Inf Med Unlocked. 2019.
15. Dheeba J, Albert Singh N, Tamil Selvi S. Computer-aided detection of breast cancer on mammograms: A swarm intelligence optimized wavelet neural network approach. J Biomed Inform. 2014.
16. Dilsizian SE, Siegel EL. Artificial Intelligence in Medicine and Cardiac Imaging: Harnessing Big Data and Advanced Computing to Provide Personalized Medical Diagnosis and Treatment.

17. Qi, H., Diakides, N.A.: Thermal infrared imaging in early breast cancer detection-a survey of recent research. In: Proceedings of the 25th Annual International Conference of the IEEE Engineering in Medicine and Biology Society (IEEE Cat. No.03CH37439), vol. 2, pp. 1109–1112 (2003)
18. Selvathi, D., Aarthy Poomila, A.: Deep learning techniques for breast cancer detection using medical image analysis. In: Biologically Rationalized Computing Techniques For Image Processing Applications, pp. 159–186. Springer International Publishing (2018)
19. Etehadtavakol, M., Ng, E.Y.K.: Breast thermography as a potential non-contact method in the early detection of cancer: a review. *J. Mech. Med. Biol.* 13(02), 1330001 (2013).
20. Z. Jiao, X. Gao, Y.Wang, and J. Li, "A deep feature based framework for breast masses classification," *Neuro computing*, vol. 197, pp. 221_231, July. 2016.
21. H. Chougrad, H. Zouaki, and O. Alheyane, "Deep convolutional neural networks for breast cancer screening," *Comput. Methods Programs Biomed.*, vol. 157, pp. 19_30, Apr. 2018.
22. M. A. Al-Masni, M. A. Al-Antari, J.-M. Park, G. Gi, T.-Y. Kim, P. Rivera, E. Valarezo, M.-T. Choi, S.-M. Han, and T.-S. Kim, "Simultaneous detection and classification of breast masses in digital mammograms via a deep learning YOLO-based CAD system," *Comput. Methods Programs Biomed.* vol. 157, pp. 85_94, Apr. 2018.
23. J. Arevalo, F. A. González, R. Ramos-Pollán, J. L. Oliveira, and M. A. G. Lopez, "Representation learning for mammography mass lesion classification with convolutional neural networks," *Comput. Methods Programs Biomed.*, vol. 127, pp. 248_257, Apr. 2016.