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Automated Detection of Breast Lump/ Masses through Mammogram Image Analysis

Dr. Seshaiah Merikapudi[1], Prof. Rame Gowda M[2], Dr. Shwetha V[3*], Dr. Harshavardhana Doddamani[4]

[1,4]*Associate Professor, Department of CSE, SJC Institute of Technology, Chickballapur, Karnataka India.*
[3*]*Associate Professor, Department of ECE, SJC Institute of Technology, Chickballapur, Karnataka India.*
[2]*Assistant Professor, Department of ECE, SJC Institute of Technology, Chickballapur, Karnataka India.*

Email: [1]merikapudi@gmail.com,[2]rgm785@gmail.com, [4]hdoddamani@gmail.com
Corresponding Email: [3]shwethamtech@gmail.com*

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Abstract: Current technology is playing a key role in the field of health care. As everything is getting automated here is an attempt to automate the identification of lumps in the breast. Lump in the breast can be a sign of breast cancer. The uncontrolled growth of breast cells is the reason for lumps or cancer in the breast. Not all lumps in the breasts are cancer. Still early identification and staging of the disease is critical in planning the treatment of breast cancer. In late stages malignancy can extend beyond the breast and spread to surrounding structures. Mammogram is the gold standard procedure in the diagnosis of carcinoma of breast cancer. In this article we have made an attempt to spot out the lump in the breast with the aid of technology. We have also attempted to extend our work to identify the stage of the cancer.

Keywords: Breast Lump, Mammogram, Screening, Tumour.

1. INTRODUCTION

The breast / Mammary gland is a modified sweat gland present in the pectoral region. It is made of glandular tissue supported by fibro-fatty stroma [1]. It is important to note that breast anatomy can vary among individuals, and breasts can change throughout a person's lifetime due to factors such as hormonal fluctuations, pregnancy, breastfeeding, and aging. Regular breast self-exams and screenings are essential for detecting any changes or abnormalities [2].

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A breast lump refers to a localized swelling or mass that can be felt in the breast tissue [3]. Discovering a lump in the breast can be a cause for concern, but it's important to note that not all breast lumps are cancerous. In fact, the majority of breast lumps are benign (non-cancerous). However, any new or unusual lump in the breast should be evaluated by a healthcare professional to determine its cause and appropriate management.

There are various potential causes of breast lumps, including Fibrocystic Changes: Many women experience benign changes in breast tissue related to hormonal fluctuations during their menstrual cycles. These changes can lead to the formation of fluid-filled cysts or areas of thickened tissue, resulting in palpable lumps [4]. Fibroadenomas: Fibroadenomas are common benign tumors that can occur in the breast. They typically present as a solid, rubbery lump that can move under the skin [5]. Rests are like, breast Infection or Abscess [6], Trauma or Injury (such as a bruise or contusion, can lead to the development of a lump) [7], fluid-filled cysts and lipoma [8].

While most breast lumps are not cancerous, breast cancer can also present as a lump. It's important to note that breast cancer can have various appearances, and not all breast cancers manifest as palpable lumps. Hence, it is crucial to seek medical evaluation if someone discovers a breast lump or notices any changes in the breast during a self-examination.

Existing system: A healthcare professional can perform a clinical breast examination, order imaging tests (such as mammography or ultrasound), and, if necessary, recommend a biopsy to determine the nature of the lump. Patients with lump/ mass in the breast are usually subjected to radiological procedures to visualize the lesion. The imaging modalities include Ultrasound (USG) examination, Magnetic resonance imaging (MRI) and Mammogram. Among them, mammogram is widely used in the diagnosis of lesions in the breast owing to its cost effectiveness, accuracy in defining the lump/ mass and feasibility. Early detection and timely medical evaluation are key in diagnosing and treating any potential breast issues [9,10].

2. RESEARCH METHODOLOGY

A large data set containing mammogram images of breasts with different sizes and shapes had been captured. This data set also includes images of different sizes and shapes of lumps/ masses of carcinoma of breast of different stages. All these data sets are analysed and classified into different categories. The categories include mammograms of normal breasts with different sizes and shapes, different lumps size and stage1 to stage 4 breast cancer. Data set images are processed to extract only desired information. All mammogram images are generally grayscale images. These images have pixels ranging from 0 to 255, where 0 is white pixels and 255 is completely black pixels. Gray scale images can be directly used to get edges of the image.

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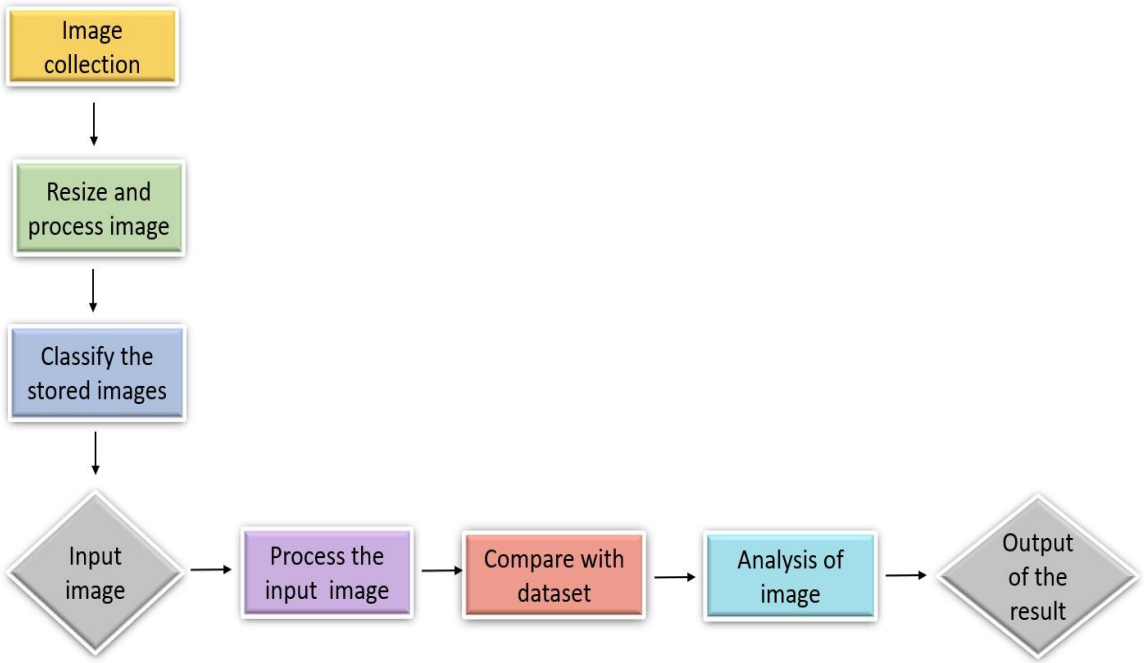

Fig.No-1 Represents the flow process of the system.

1. Image collection: Mammogram images of different breast size and shapes are collected. A huge dataset is captured for more accuracy nearly 110 images are captured out of which 20 images are without any lumps that is healthy breasts of different shape and size of mammograms
2. Resize and Process image: all images are maintained or resized to have the same size and shapes and then they are transferred to gray scale which helps to highlight the desired region in the image.
3. Classify and store the image: These images are identified with the help of professionals and categorized and stored in different files like healthy, stage1, stage2, stage3 and stage4 images. These are based on the area or visibility of the lump region.
4. Input image: Input the image to be processed and resize the image to the standard size.
5. Process the input image: convert the input image to gray scale image and then to black and white image this black and white images can then be transferred to detect edges and this is used to identify the desired regions.
6. Compare with the dataset: The processed image is then compared with the dataset that is maintained until a suitable match is detected. Once the match is identified the comparison of the image is halted based on the most suitable image.
7. Analysis of the Image: Image is then analysed to which file or folder it suitably belongs. Like healthy, stage1, stage2, stage3, or stage 4.
8. Output of the result: Based on the analysis the results are obtained.

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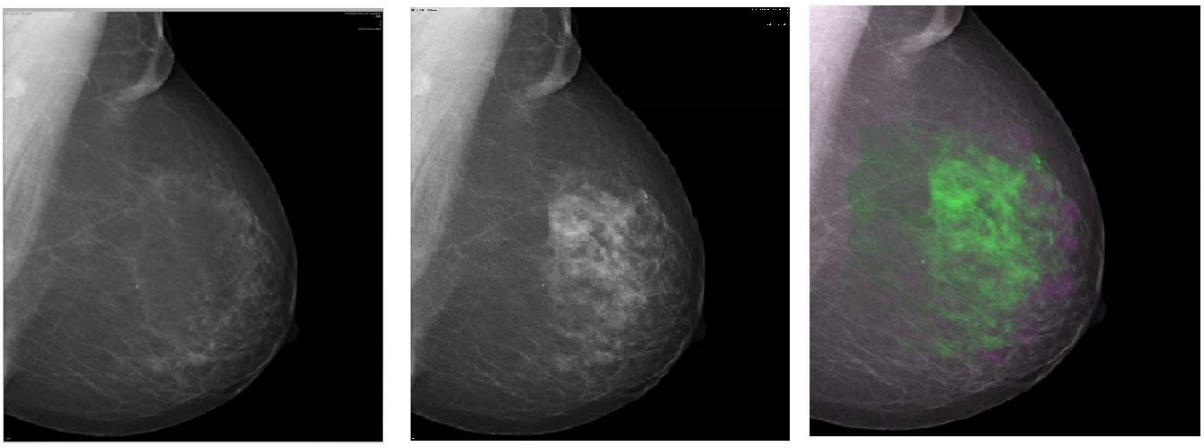
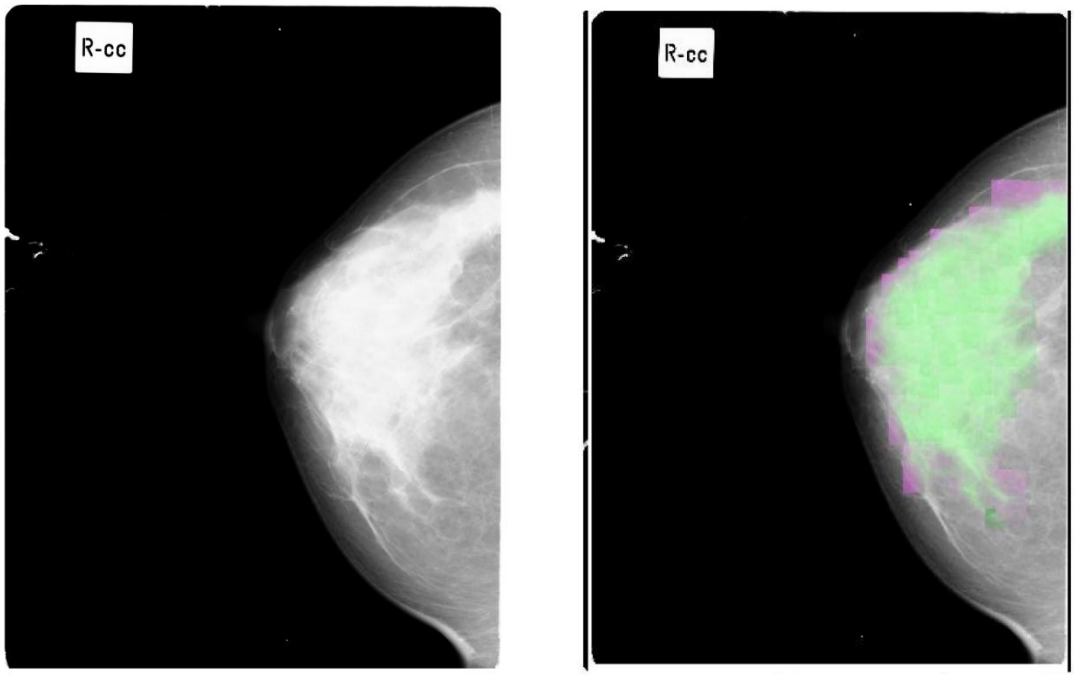


Fig.No-2



Stage 3 Analysis

Fig.No-3 Showing stage 3 analysis

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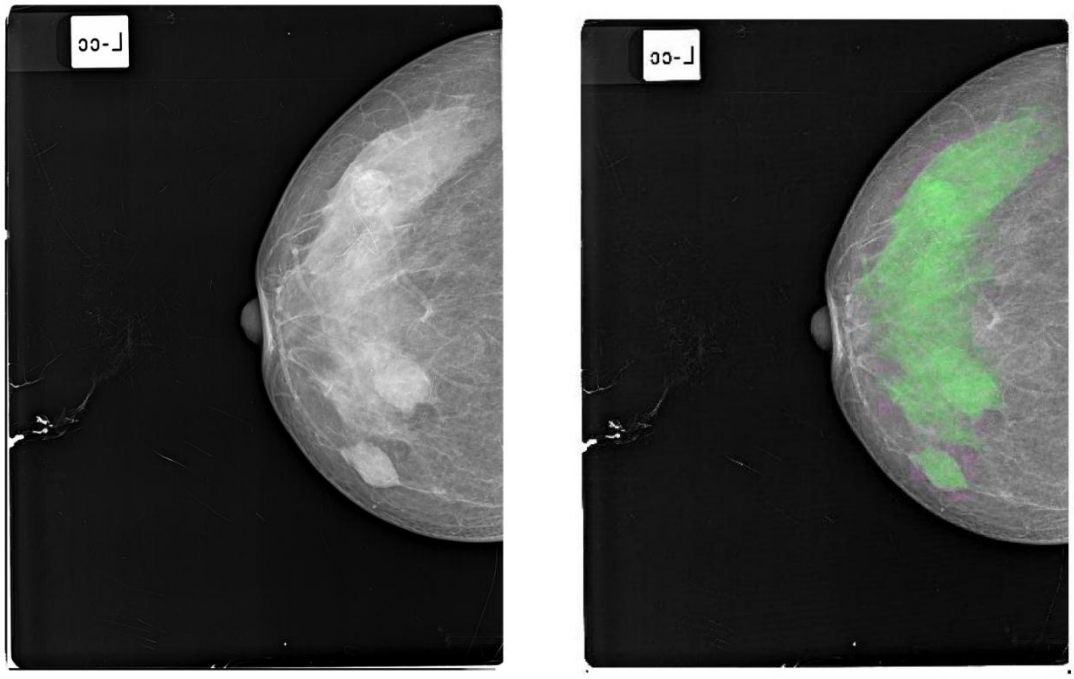

Stage 4 Analysis

Fig.No-4 Showing stage 4 analysis

3. RESULTS

This is completely based on the analysis and classification by professionals. This system can be extended to increase the accuracy by having more dataset somewhere the system is not accurate enough to differentiate cancer and lumps. But still we could get some satisfactory analysis which could be further enhanced and elaborated.

4. DISCUSSION

The bulk of the breast / mammary gland, is composed of glandular tissue supported by fibro fatty tissue. Each breast is compartmentalized into 15-20 lobes, the fibrous septa. Lobes are in turn made of lobules containing acini, which secrets milk. Lobules are drained by the lactiferous ducts, which ultimately open into the nipple after converging under the areola. Mammary gland is supported by the pectoral muscles with intervening retromammary space. Ligaments extend from skin to the chest, thereby supporting the breast. Mammary glands are mainly drained by axillary lymph nodes, which get affected during infection/ malignancy (11).

Lump/ mass in the breast is a frequent complaint encountered in medical practice. Worldwide around 25% of women are affected by this condition in their lifetime. Lump in the breast could be due to physiological adenosis or pathological processes. The pathological process can result in either a benign or a malignant lesion. Common benign breast lesions are fibroadenoma, breast abscess, breast cyst etc. On the other hand, malignancies of breast affect around 12%

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of the population every year. It is not surprising to note that there are quite a good number of reported cases of breast carcinoma of breast in males(12). As per WHO, breast cancers are the leading cause of death across the globe. Various risk factors have been blamed for the etiology of the carcinoma of breast. Increased estrogen exposure is often correlated for the disease and it is observed in early menarche, multiple pregnancies, hormone replacement therapy/ oral contraceptive pill use and late menarche (13).

Three effective modalities in the diagnosis of lump in the breast are clinical examination, imaging and pathological assessment (14). Among the existing imaging techniques, mammography is commonly used to screen the patients of lump/mass in the breast. In this technique low dose X-rays are used and the image of the breast is captured on film. The glandular/ fibrous tissue appears more thicker and dense in the film compared to the fat. Dense tissue forms a bright/ white shadow than the less dense tissue (9). It is often challenging for an expert to figure out the lump/mass in the mammogram of a dense breast. Breast imaging Reporting and data system (BIRADS) is the standardized tool used to describe the lump in the breast. While defining the lump/ mass BIRADS considers few criterias like density, location, asymmetry, any calcification and other related features. As per the BIRADS, lesion is called lump/ mass only if it exhibits convex border, peripheral dense region and visibility in two different projections. Patients with lump in the breast are categorized into 6 groups based on criterias of BIRADS(15,16).

Technology has significantly revolutionized the quality of image and speed with which it can be acquired. But the interpretation of images has to be done by expertise which depends on their availability. Mammograms are usually read by one or two experts. Double reading is preferred in many countries to ensure higher sensitivity and specificity. But there may be a significant time difference between the procedure done and diagnosis obtained in this process. This can result in significant anxiety and apprehension in the patients. This might be frequently encountered during community screening. In order to overcome this delay between the process and diagnosis, image processing is frequently used in the medical field so as to accelerate the whole process. In the treatment of carcinoma of breast, early identification and staging is very crucial. It is essential to differentiate the benign lesion from malignant lesion. Treatment protocol of carcinoma of breast is based on the staging of the disease and it is a multi-speciality team work. Accurate staging is must for successful treatment of the disease. Medical image processing comprises lesion identification, image segmentation, registration and fusion. Medical image process thus can automate the whole process of screening and diagnosis. Not only in diagnosis, medical imaging aids in teaching, planning surgery, research and producing simulation (17,18,19,20).

5. CONCLUSION

In the current fast forward technology everything is getting automated here is an attempt to automate the mammogram analysis. These predicted results are then given to experts to check the accuracy of the proposed system.

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