A NOVEL BREAST CANCER DETECTION IN ULTRASOUND IMAGE BASED ON YOLO v4

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Abstract: *Breast cancer is one of the leading causes of death among women worldwide, and early detection significantly improves survival rates. Ultrasound imaging is a widely used, non-invasive and cost-effective method for breast cancer diagnosis. However, manual interpretation of ultrasound images is time-consuming and prone to human error. This paper presents a computer aided diagnosis(CAD)-based YOLOv4 to segment pectoral muscle region and classify tumor cells. The model is optimized to achieve better accuracy in real-time tumor detection by fine-tuning parameters. We compare our method with state-of art criteria like U-Net interms of accuracy and we prove that our method yields better results. The proposed approach was tested on kaggle dataset and achieved high performance with an accuracy (Acc) of* 99.8%.

Keywords: Ultrasound images, YOLO v4 model, Pictorial muscles, CAD, Segmentation, Feature extraction, Classification, Accuracy

1.INTRODUCTION

Breast cancer stands as one of the most prevalent cancers worldwide, with a substantial impact on public health. According to the World Health Organization (WHO), breast cancer is the most common cancer among women globally, with an estimated 2.3 million new cases diagnosed annually and over 685,000 deaths attributed to the disease. Early detection of breast cancer is crucial for timely treatment and improved patient outcomes, emphasizing the importance of accurate and efficient diagnostic methods. Medical imaging plays a critical role in breast cancer diagnosis, with modalities such as mammography, magnetic resonance imaging (MRI), and ultrasound being widely utilized. Among these, ultrasound imaging offers several advantages, including non-invasiveness, real-time imaging capabilities, and absence of ionizing radiation, making it particularly suitable for screening younger women and for assessing dense breast tissue. In recent years, deep learning has emerged as a powerful tool for medical image analysis, offering the potential to learn discriminative features directly from data and to adapt to variations in image characteristics. Convolutional neural networks (CNNs), in particular, have demonstrated remarkable success in various medical image segmentation tasks, including brain tumor segmentation, lung nodule detection, and cardiac image analysis.Traditional segmentation algorithms often rely on handcrafted features and mathematical models, which may struggle to adapt to the diverse and nuanced characteristics of ultrasound images. Deep learning approaches, on the other hand, offer a data-driven alternative by leveraging large-scale datasets to learn hierarchical representations directly from raw data, thereby circumventing the need for manual feature engineering. YOLOv4 (You Only Look Once version 4) is a state-of-the-art real-time object detection algorithm introduced by Alexey Bochkovskiy et al. in 2020. It is an improvement over its predecessors (YOLOv1, YOLOv2, and YOLOv3), offering a better balance between detection accuracy and speed, making it highly suitable for applications like real-time medical image analysis, surveillance, and autonomous driving. YOLOv4 is a one-stage detector, meaning it predicts bounding boxes and class probabilities in a single pass through the neural network, unlike two-stage detectors such as Faster R-CNN. This contributes to its high inference speed.

1. PROPOSED METHOD

The proposed method involves training the YOLOv4 model on a dataset containing benign and malignant breast lesions. YOLO v4 is used to extract pectorial muscle area ,store as feature vector and used as classifier to segment and classify tumor area. Performance evaluation is conducted using standard metrics such as accuracy, psnr, mse. The results demonstrate that

YOLOv4 outperforms traditional machine learning and other deep learning models in terms of detection speed and accuracy. The effectiveness of YOLOv4 for breast cancer detection in ultrasound images, offering a potential solution for early diagnosis and assisting radiologists in clinical decision making Traditional segmentation algorithms often rely on handcrafted features and mathematical models, which may struggle to adapt to the diverse and nuanced characteristics of ultrasound images. Deep learning approaches, on the other hand, offer a data-driven alternative by leveraging large-scale datasets to learn hierarchical representations directly from raw data, thereby circumventing the need for manual feature engineering. YOLOv4 (You Only Look Once version 4) is a state-of-the-art real-time object detection algorithm introduced by Alexey Bochkovskiy et al. in 2020. It is an improvement over its predecessors (YOLOv1, YOLOv2, and YOLOv3), offering a better balance between detection accuracy and speed, making it highly suitable for applications like real-time medical image analysis, surveillance, and autonomous driving. YOLOv4 is a one-stage detector, meaning it predicts bounding boxes and class probabilities in a single pass through the neural network, unlike two-stage detectors such as Faster R-CNN. This contributes to its high inference speed..

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2. METHODOLOGY

3.1 INPUT IMAGES:

The steps to get an image start with getting a group of images from the database. The group of images getting from the kaggle.com website Wisconsin database. that images are usually displayed in standard formats(e g jpg, jpeg, .png) and uploaded using the OpenCV framework.

3.2 PROCESSING IMAGE:

The first step in breast cancer tumor detection involves taking the input dataset and the image will undergo segmentation technique .Image segmentation is the process of dividing a digital image into multiple segments that will be helpful in further Processes. In Performance analysis, the performance is analysed from the input images will be extracted and then the acquired analysis will be compared with the trained dataset. In the end, after comparing with the trained dataset the output will tell whether the tumor is present or not. If the tumor exists the output will be benign or malignant or else the output will be as normal.

3.3 IMAGE SEGMENTATION

Segmentation is a method of breaking up an image into smaller pieces. Performed to facilitate analysis Segmentation in this project refers to the method of dividing an image into many segments, however the greatest difficulties in segmentation are related to the degree of the image, and images are also not inherited in a continuous area. When the restriction that regions connect is removed, the defining sets are called pixel classifications, and therefore the sets themselves are called classes.

3.4 FEATURE EXTRACTION

It is the process by which certain features of interest in an image are detected and presented for further processing. This is an important step in most computer vision and imaging solutions. Based on the results obtained during the extraction of signs, the tumor is classified. When extracting, certain parameters are taken into account: size, shape, composition, image location. This step extracts the features of the given input image. Based on these characteristics, the image is analyzed and the area of the tumor is determined.

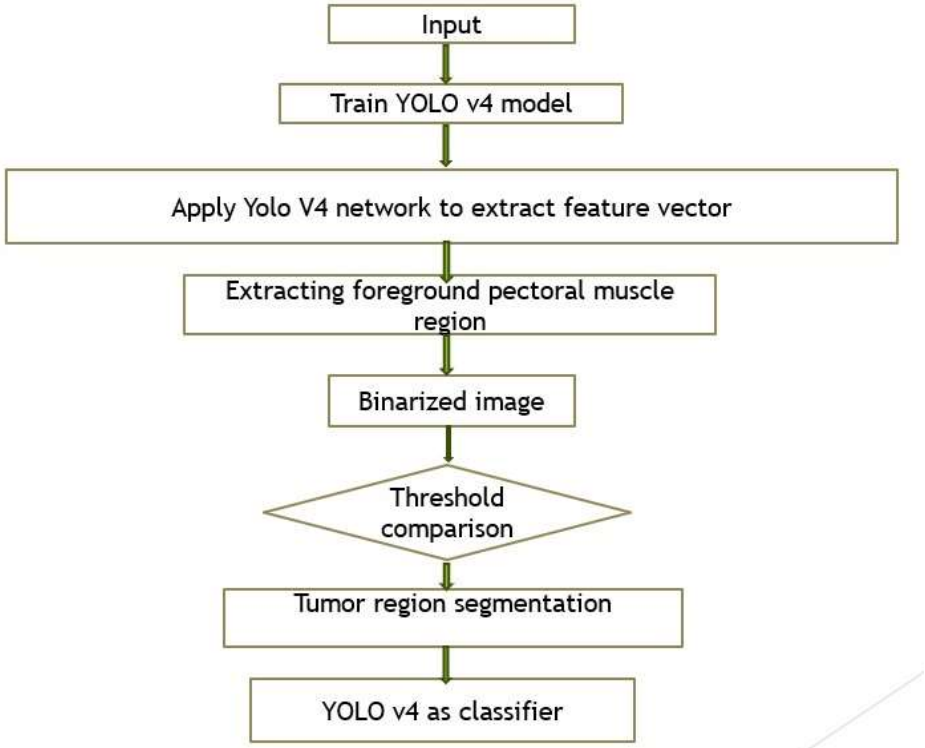

Fig.1: FLOW CHART FOR BREAST CANCER DETECTION

4. IMPLEMENTATION AND RESULT ANALYSIS

4.1. IMPLEMENTATION:

Ultrasound Images: The input to the segmentation model consists of RGB ultrasound images of the breast. These images are acquired using ultrasound imaging equipment and depict the breast tissue, including both normal tissue and tumor regions.

Fig.1 Training Progress

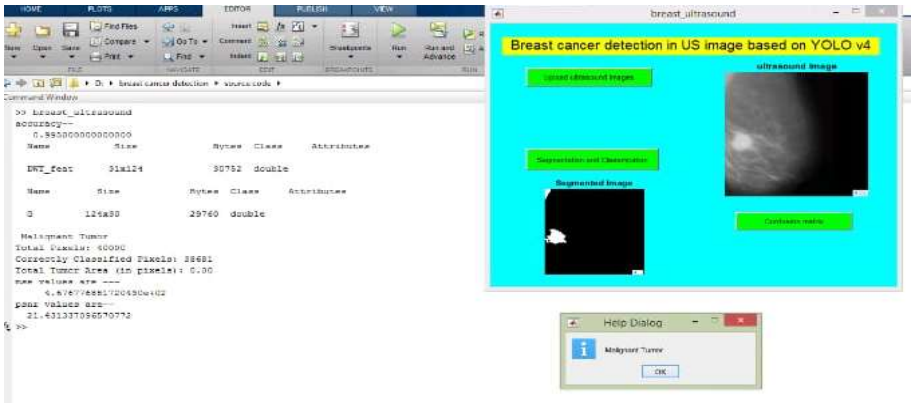

Fig.2.CLASSIFICATION IMAGE

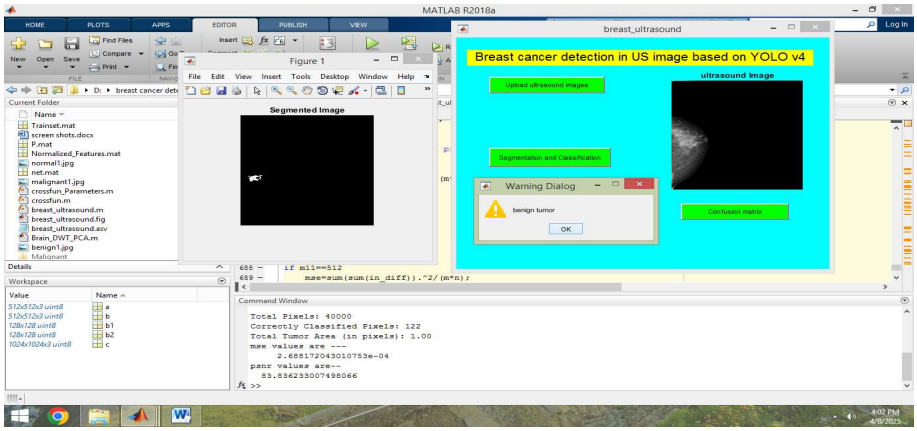

Fig. 3. BENIGN OUTPUT IMAGE

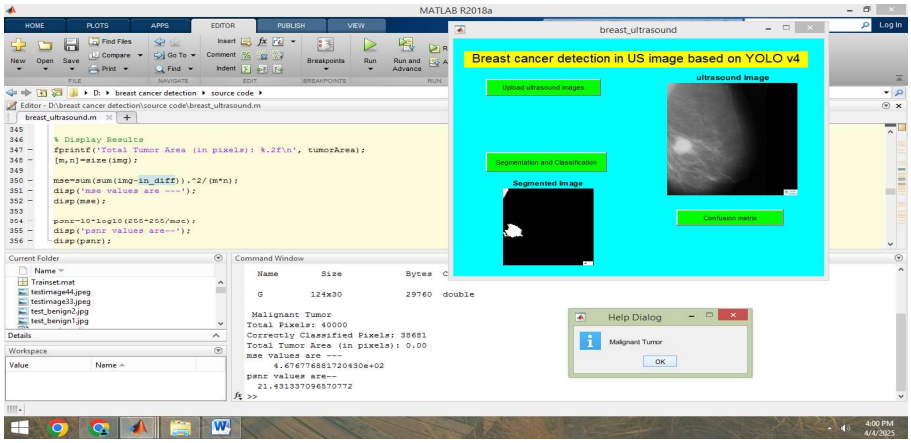

Fig.4. MALIGNANT OUTPUT IMAGE

Table.1. Comparision Table

S.NO	TYPES OF IMAGES	ACCURACY	MSE	PSNR
1	NORMAL	99.4	5.06	21.08
2	MALIGNANT	99.5	4.67	21.43
3	BENIGN	99.8	2.68	83.88

5.CONCLUSION AND FUTURE SCOPE

5.1 CONCLUSION

This study presents a novel segmentation and classification scheme for breast tumor ultrasound images. A segmentation model named YOLO v4 is introduced that is optimized. The segmentation is employed on ultrasound images, done for revelant and better ROI segmented image. A YOLO v4 model is developed for the superior classification. The result of the proposed YOLO v4 model is compared with tranfer learning models is used to assess its performance stability. Several performance metrics like accuracy, psnr, mse show the effectiveness of the proposed technique. A Sonogram dataset is also employed to classify breast cancer with the proposed model and the model gives a noteworthy performance. This study relies on image processing to achieve the better accuracy in segmentation and classification and shows a promising performance in the diagnosis of breast cancer from ultrasound image. Moreover, YOLO v4 model advance the segmentation and classification of breast tumor from ultrasound images,introducing a promising path for advanced medical image analysis.

5.2 FUTURE SCOPE

In future, we can use Faster R-CNN methodology in Digital Breast Tomosynthesis images. Digital Breast Tomosynthesis images creates a 3 Dimensional picture of breast using X-rays. A novel faster R-CNN based frame work will be implemented to automate the detection of DT pathological lesions. It is possible to create a more robust training dataset to feed deep learning models, reducing the computation time, dimension of the dataset and to improve accuracy

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