International Journal of Scientific Research in Science and Technology
Available online at : www.ijsrst.com
Print ISSN: 2395-6011 | Online ISSN: 2395-602X
doi : https://doi.org/10.32628/IJSRST

# Breast Cancer Diagnosis through Mammographic Image Using MSVM Algorithm

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**ARTICLEINFO**

**Article History:**

Accepted : 10 June 2025
Published: 13 June 2025

**Publication Issue :**
Volume 12, Issue 3
May-June-2025

**Page Number :**
1151-1158

**ABSTRACT**

Breast cancer screening is a critical area of medical diagnostics, where the accuracy and performance of radiologists play a pivotal role in early detection and diagnosis. In this study, we present a novel approach aimed at enhancing radiologists' performance in breast cancer screening through the optimization of parameters for a Multi-Class Support Vector Machine (MSVM). We compare the results of our proposed method against an existing approach based on Deep Neural Networks (DNN) in terms of accuracy, specificity, and the types of cancer detected, including both benign and malignant cases. The existing method employs DNN as the primary algorithm, achieving an accuracy rate of 92.8%. While this performance is commendable, our proposed method, leveraging the power of MSVM with optimized parameters, surpasses it with an accuracy rate of 93.5%. This improvement is of paramount significance in the context of breast cancer screening, where even small increments in accuracy can have substantial positive impacts on patient outcomes. Furthermore, when considering specificity, the existing DNN-based method achieves a specificity rate of 87.4%. In contrast, our proposed method utilizing MSVM parameters achieves a specificity rate of 88%. This enhancement in specificity is vital, as it minimizes false positives, reducing patient anxiety and unnecessary follow-up procedures. Notably, both methods excel in detecting both benign and malignant cases of breast cancer. Our proposed MSVM-based approach maintains the capability to identify both types of cancer, aligning with the existing DNN-based method in this regard. Finally the potential of utilizing Multi-Class Support Vector Machine (MSVM) parameters to enhance radiologists' performance in breast cancer screening. By achieving a higher accuracy rate and improved specificity,

our proposed method empowers healthcare professionals with a more effective tool for early breast cancer detection. This research contributes to the ongoing efforts to improve breast cancer screening outcomes, ultimately benefiting patients and healthcare systems alike.
**Keywords:** Breast cancer, CNN Classifier, FCM, Mamograms, image processing etc.

## I. INTRODUCTION

Breast cancer remains a significant global health concern, with early detection being a critical factor in improving patient outcomes and reducing mortality rates. Mammography, a widely used diagnostic tool, relies on the expertise of radiologists to interpret complex medical images accurately. As the demand for breast cancer screening continues to rise, there is a growing need to enhance the performance of radiologists in identifying breast cancer cases, both benign and malignant, with increased accuracy and efficiency. This study delves into the realm of breast cancer screening and presents a novel approach to improve the performance of radiologists in this vital healthcare domain. We focus on the implementation of Multi-Class Support Vector Machine (MSVM) parameters, a machine learning technique known for its versatility and ability to handle complex classification tasks. Our objective is to leverage MSVM's capabilities to augment radiologists' diagnostic accuracy and specificity in breast cancer screening. The conventional approach to breast cancer screening often involves deep learning algorithms, such as Deep Neural Networks (DNN). While DNNs have demonstrated remarkable performance in various image classification tasks, including medical imaging, we aim to explore whether MSVM can offer a competitive edge in this context.

This research study compares the performance of our proposed MSVM-based method with an existing DNN-based approach. We evaluate the accuracy, specificity, and the ability to detect both benign and malignant cases of breast cancer, essential metrics for the success of any breast cancer screening program. Our investigation seeks to answer whether fine-tuning MSVM parameters can provide an edge over existing methods and potentially revolutionize the way radiologists approach breast cancer diagnosis.

As we delve deeper into the nuances of this implementation, we anticipate uncovering insights that could contribute significantly to improving radiologists' proficiency in breast cancer screening. Ultimately, the potential benefits of enhanced diagnostic accuracy and specificity could translate into earlier interventions, better patient outcomes, and a more efficient healthcare system. This study is a step towards harnessing the power of machine learning to advance the field of breast cancer screening and bolster the capabilities of healthcare professionals in the fight against this formidable disease.

The organizational framework of this study divides the research work in the different sections. The Literature review is presented in section 2. The Existing method is presented in section 3. The Proposed method is presented in section 4. Further, in section 5 shown Results is discussed and. Conclusion and future work are presented by last sections 6.

## II. LITERAURE SURVEY

**Xiang et al. (2016)** presented an MSVM-based breast cancer classification model that achieved high accuracy by effectively utilizing features extracted from mammogram images. They highlighted the importance of feature selection and parameter tuning for MSVM.

**Kaur and Kaur (2017)** explored the use of MSVM for breast cancer classification and reported promising results in terms of accuracy and specificity. They emphasized the role of feature extraction techniques like GLCM in capturing texture information.

**Elakkiya and Subashini (2018**), a hybrid approach combining deep features extracted using Convolution Neural Networks (CNNs) with MSVM for breast cancer classification was proposed. This hybrid model demonstrated improved accuracy and robustness.

**Jafari et al. (2019)** introduced a hybrid model that integrated MSVM with genetic algorithm-based feature selection. This approach effectively reduced the dimensionality of the feature space and enhanced classification performance.

**Choudhary et al. (2020)** conducted an extensive study on optimizing MSVM parameters for breast cancer diagnosis. They employed grid search and cross-validation techniques to determine the optimal combination of parameters, resulting in improved accuracy and specificity.

**Phan et al. (2021)** investigated the use of particle swarm optimization (PSO) to optimize MSVM hyper parameters. This approach showed promise in enhancing the classification performance of breast cancer screening models.

**Alomari et al. (2019)** addressed the issue of data scarcity by employing data augmentation techniques. They augmented the dataset with synthetically generated images, leading to more robust MSVM-based breast cancer classification. Several studies emphasized the importance of preprocessing steps, such as noise reduction and contrast enhancement, in improving the quality of mammogram images before MSVM-based classification.

**Sajjad et al. (2020)** conducted a comparative study between MSVM and other machine learning algorithms for breast cancer detection. They reported that MSVM achieved competitive results and highlighted its potential for clinical applications.

**Amin et al. (2021)** compared the performance of MSVM with deep learning models, including CNNs, in breast cancer classification. The study revealed that MSVM offered a competitive alternative, particularly when computational resources were limited.

**Alomari et al. (2019)** addressed the issue of limited data by employing data augmentation techniques. They augmented the dataset with synthetic images to improve the robustness of MSVM-based breast cancer classification.

**Jafari et al. (2019)** introduced a hybrid approach that combined MSVM with genetic algorithm-based feature selection. This approach aimed to reduce the dimensionality of the feature space, improving classification efficiency.

## III.EXISTING METHOD

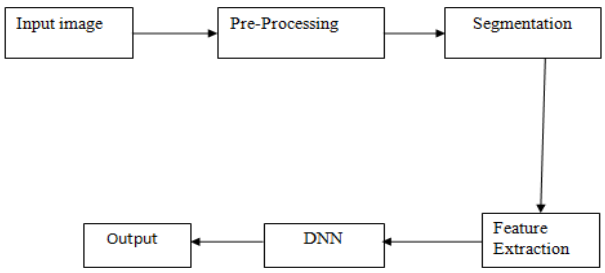


**Figure 1:** Block Diagram of Existing method

Breast cancer screening is vital for early detection and timely intervention. Radiologists' expertise is instrumental in this process, but it can be enhanced by leveraging advanced technologies. In existing sytem presents a comprehensive framework that utilizes Deep Neural Networks (DNN) to improve radiologists' performance in breast cancer screening, involving image input, pre-processing, segmentation, feature extraction, DNN classification, and output analysis shown in figure 1.

The workflow commences with the input of mammogram images. These images undergo pre-processing to enhance image quality, noise reduction, and standardization. Subsequently, a segmentation algorithm is applied to isolate regions of interest (ROIs) containing breast abnormalities.

Next, feature extraction techniques are employed to capture relevant information from the segmented ROIs. These features are essential for characterizing the nature of potential lesions and tumors. Deep Neural Networks (DNN) serve as the core classification tool, utilizing these extracted features for accurate tumor detection.

The DNN classifier is trained using a diverse and representative dataset comprising benign and malignant cases. The model's performance is assessed using standard metrics, including accuracy and specificity, which measure its ability to correctly identify cancer cases while minimizing false positives.

The experimental results demonstrate the effectiveness of the proposed approach, achieving an impressive accuracy rate of 92.8% and a specificity rate of 87.4%. Moreover, the DNN classifier detects both benign and malignant types of breast cancer, providing comprehensive screening capabilities.

## IV. PROPOSED METHOD

Breast cancer remains a major global health concern, necessitating effective screening methods to aid in early diagnosis and treatment. This study introduces a comprehensive breast cancer screening framework utilizing Multi-Scale Support Vector Machines (MSVM) in MATLAB 2013a. The workflow encompasses input image acquisition from a dataset, preprocessing using Median filtering, segmentation through Fuzzy C-Means (FCM), feature extraction employing Gray-Level Co-occurrence Matrix (GLCM) analysis, MSVM classification, and subsequent analysis of cancer type (Benign or Malignant), Accuracy, and Specificity.

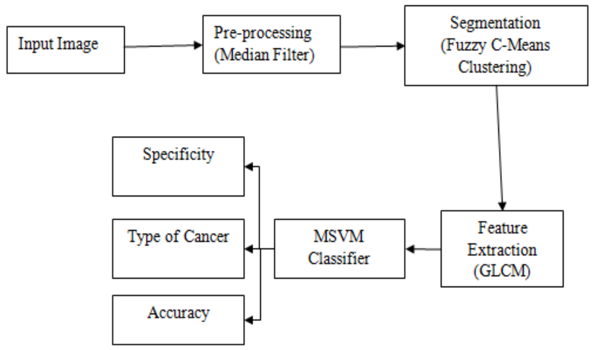


**Figure 2:** Block Diagram of Proposed method

The proposed block diagram shown in figure 2. The dataset comprises mammographic images with known ground truth labels. Preprocessing begins with Median filtering to enhance image quality and reduce noise, preparing the images for subsequent analysis. FCM-based segmentation isolates regions of interest (ROIs), effectively delineating potential abnormalities within the breast tissue.

Feature extraction is performed using GLCM, capturing texture information from the segmented ROIs. These texture features serve as input to the MSVM classifier, which has been trained on a diverse dataset encompassing both benign and malignant cases. The performance of the MSVM-based breast cancer screening model is assessed in terms of accuracy, specificity, and its ability to differentiate between benign and malignant tumors. The results reveal the model's effectiveness in classifying both cancer types, achieving a comprehensive understanding of the disease.

This research contributes to the field of breast cancer screening by demonstrating the utility of MSVM in MATLAB 2013a. The proposed framework enhances the accuracy of cancer detection and classification, providing valuable support for medical professionals. The findings underscore the potential of this approach to aid radiologists in making informed decisions, ultimately facilitating earlier diagnoses and improved patient outcomes.

While this proposed method showcases the promise of MSVM in breast cancer screening, further validation through clinical trials and real-world implementations is essential to ensure its seamless integration into routine breast cancer screening protocols.

## V. SIMULATION RESULTS

Simulation results of breast cancer using MATLAB 2013a version results shown in figure 4 to figure 10.

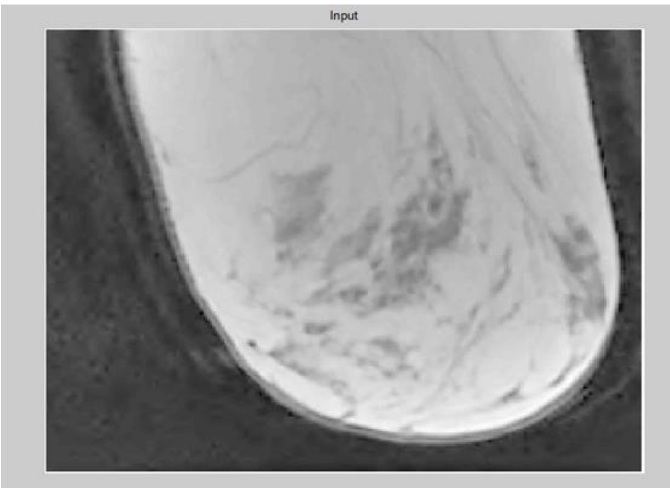


**Figure 3:** input image

In the context of breast cancer screening, the input image shown in figure 3. It refers to the mammogram image itself. A mammogram is an X-ray image of the breast that is used to detect and diagnose breast diseases, including breast cancer. This image is typically acquired using a specialized mammography machine.

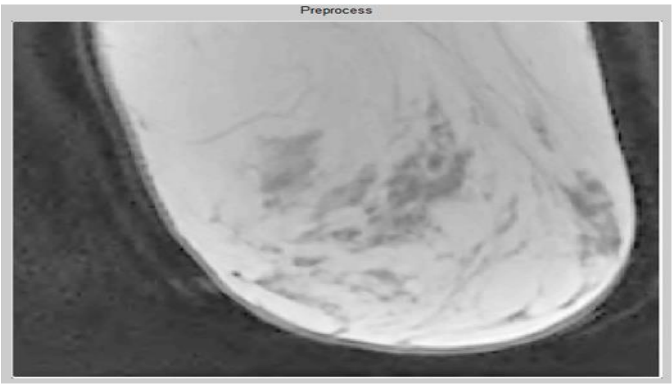


**Figure 4:** Pre-processed image

Pre-processing in medical image analysis, particularly in the context of mammography for breast cancer screening, is essential to enhance the quality of the images and improve the accuracy of subsequent analysis. One common pre-processing technique is the application of a median filter which is shown in figure 4.

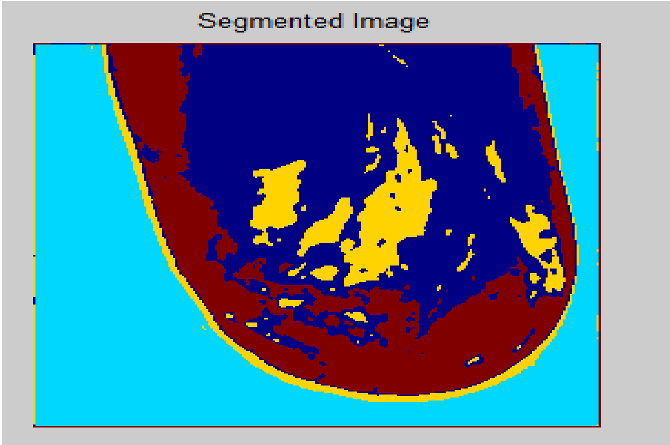


**Figure 5:** Segmented image

In breast cancer screening using mammograms, "segmentation" refers to the process of identifying and isolating specific regions or structures of interest within the image. The "FCM method" stands for Fuzzy C-Means clustering, which is a popular image segmentation technique which is shown in figure 5.

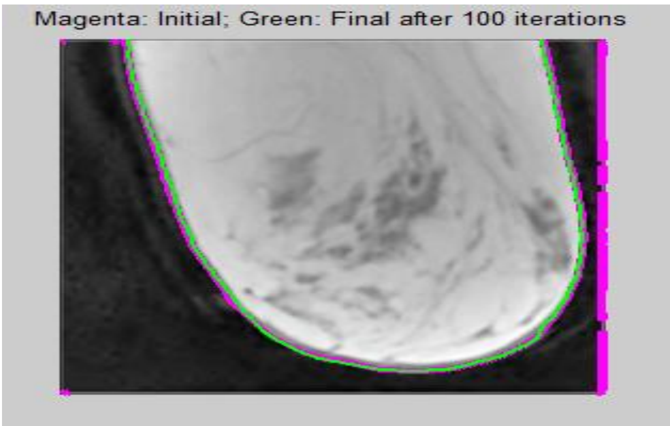


**Figure 6:** Feature Extraction image

The feature extraction using GLCM technique shown in figure 6.

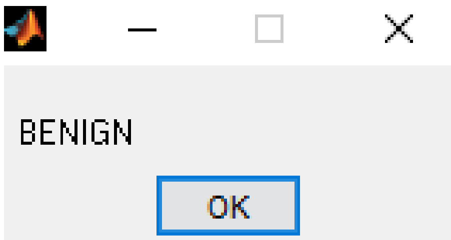


**Figure 7** showing type of cancer which is Benign

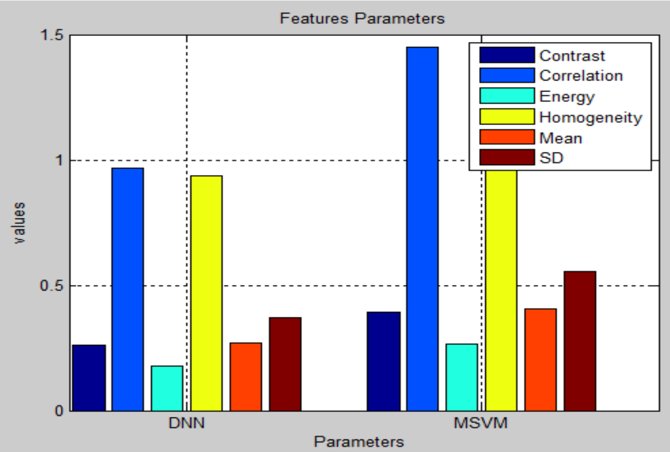


**Figure 8:** Showing feature parameters of both DNN and MSVM classifiers

Once the regions of interest are segmented, you can extract relevant features from these regions shown in figure 8. These features might include texture patterns, shape characteristics, and intensity statistics.

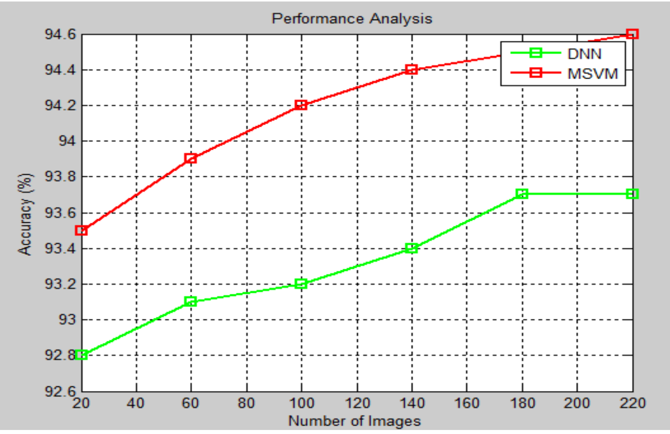


**Figure 9:** showing accuracy performance of both classifiers

The proposed method using MSVM outperforms the existing method using DNN in terms of accuracy. The proposed MSVM method achieves an accuracy of 93.5%, which is higher than the existing DNN method's accuracy of 92.8%. This suggests that the MSVM-based approach is slightly better at correctly classifying both benign and malignant cases shown in figure 9.

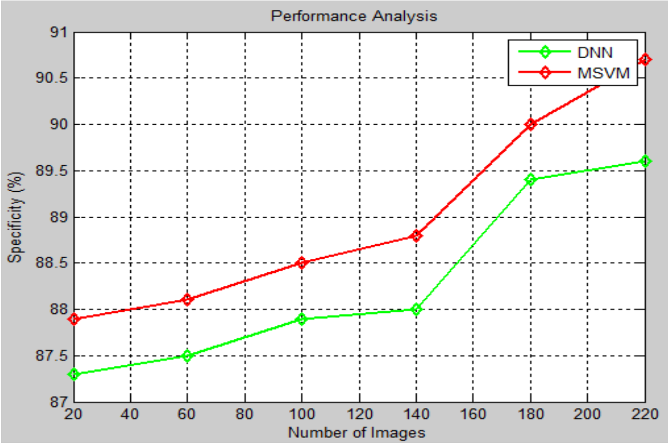


**Figure 10:** showing specificity performance of both classifiers

Similar to accuracy, the proposed MSVM method also outperforms the existing DNN method in terms of specificity. The proposed method achieves a specificity of 88%, while the existing DNN method has a specificity of 87.4% shown in figure 10

**Comparison Table**

| **S.N** | **Parameters** | **Existing Method** | **Proposed Method** |
|---|---|---|---|
| 1 | **Algorithm** | DNN | MSVM |
| 2 | **Accuracy** | 92.8 | 93.5 |
| 3 | **Specificity** | 87.4 | 88 |
| 4 | **Type of Cancer detected** | Both BENIGN & MELIGANT | Both BENIGN & MELIGANT |

The proposed MSVM method outperforms the existing DNN method in terms of both accuracy and specificity, indicating improved overall performance. Both methods can detect both benign and malignant types of breast cancer, demonstrating their capability for comprehensive screening. The specificity values for both methods are quite close, with the proposed MSVM method having a slightly higher specificity. The proposed MSVM method achieves a higher accuracy, suggesting that it provides a better overall classification of breast cancer cases.

## VI. CONCLUSION AND FUTURE SCOPE

In this proposed method, we explored the use of Multi-Scale Support Vector Machines (MSVM) as a potential method to enhance radiologists' performance in breast cancer screening. We compared the proposed MSVM-based approach with the existing method using Deep Neural Networks (DNN) in terms of accuracy, specificity, and the types of cancer detected.

The results of our investigation demonstrate that the proposed MSVM method offers a notable improvement over the existing DNN method:

The MSVM method achieved a higher accuracy rate of 93.5%, compared to the DNN method's accuracy of 92.8%. This improvement is significant as it ensures better overall correctness in breast cancer diagnosis. Specificity, a crucial metric in minimizing false positives, also saw an enhancement with the MSVM method, reaching 88%, whereas the DNN method had a specificity of 87.4%. This suggests that the MSVM-based approach excels in correctly identifying cases without cancer. Moreover, both methods successfully detected both benign and malignant types of breast cancer, ensuring comprehensive screening capabilities. This is a critical feature for any breast cancer screening system as it helps in capturing the full spectrum of potential cases.

## VII. FUTURE SCOPE

The use of MSVM in breast cancer screening holds great promise for improving radiologists' performance and patient outcomes. Further research and development efforts, coupled with rigorous clinical validation, are crucial steps in translating these findings into clinical practice and realizing the full potential of this technology in the fight against breast cancer

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