International journal of innovation in Engineering

journal homepage: www.ijie.ir

**Research Paper**

# Various Deep Learning Techniques Involved In Breast Cancer Mammogram Classification – A Survey

**Nageswara Rao Dronamraju**[a1]

[a] *Professor, Department of Computer Science and Engineering, Chitkara University Institute of engineering and Technology, Chitkara University, Punjab, India*

**ARTICLE INFO**

**Received:** 05 July 2022

**Reviewed:** 24 July 2022

**Revised:** 04 August 2022

**Accepted:** 15 August 2022

**Keywords:**

***Mammogram, Breast Cancer, Support Vector Machine, Deep Learning, CNN.***

**ABSTRACT**

The most common and rapidly spreading disease in the world is breast cancer. Most cases of breast cancer are observed in females. Breast cancer can be controlled with early detection. Early discovery helps to manage a lot of cases and lower the death rate. On breast cancer, numerous studies have been conducted. Machine learning is the method that is utilized in research the most frequently. There have been a lot of earlier machine learning-based studies. Decision trees, KNN, SVM, naive bays, and other machine learning algorithms perform better in their respective fields. However, a newly created method is now being utilized to categorize breast cancer. Deep learning is a recently developed method. The limitations of machine learning are solved through deep learning. Convolution neural networks, recurrent neural networks, deep belief networks, and other deep learning techniques are frequently utilized in data science. Deep learning algorithms perform better than machine learning algorithms. The best aspects of the images are extracted. CNN is employed in our study to categorize the photos. Basically, CNN is the most widely used technique to categorize images, on which our research is based.

[1] **Corresponding Author**
dronamraju8@gmail.com

# 1. Introduction

When the abnormal body's cells begin to separate and interact with normal cells, turning them malignant, cancer develops (Ghantasala et al., 2020a; Ghantasala & Kumari, 2021a). The most common and dangerous disease in the world is breast cancer. There are two types of breast cancer: invasive and non-invasive. Cancerous and malignant, invasive spreads to other organs (Ghantasala & Kumari, 2021b). Precancerous and non-invasive, it stays in the original organ. It ultimately progresses to aggressive breast cancer (Ghantasala et al., 2021a). The glands and milk ducts that transport milk are the area of the body where the breast cancer is located (Ghantasala et al., 2021b; Nozari & Sadeghi, 2021). Breast cancer frequently metastasized to other organs, turning them aggressive. Additionally, it spreads to other organs through the bloodstream. There are numerous forms of breast cancer, and each one grows at a distinct rate (Chandana et al., 2020). WHO reports that 627,000 women lost their lives to breast cancer in 2018 Ghantasala et al., 2021c). The biggest issue, which affects everyone in the world but is most prevalent in the United States of America, is breast cancer. Breast cancer comes in four different forms (Bhowmik et al., 2021). The first type of cancer is Ductal Carcinoma in Situ, a form of early-stage breast cancer that is detected in the covering of breast milk ducts. Up to 70-80% of cases of the second type of breast cancer are diagnosed. The third form of breast cancer is inflammatory breast cancer, in which the skin and lymphatic arteries of the breast are aggressively and swiftly penetrated by cancer cells (Nozari et al., 2022; Kishore et al., 2021). Breast cancer that has spread to other bodily areas is the fourth kind of breast cancer.

Numerous diagnostic procedures, including mammography, ultrasound, MRI, and biopsies, produced the pictures needed for classification (CADe, 2020). X-rays are used in mammograms to detect breast cancer. If any questionable results are discovered during a mammography screening, the doctor will be informed and the tissues will be tested. After the mammography, an ultrasound is performed. When a suspicious area in your breast is found, a doctor will order an ultrasound. If the tests performed during a symptomatic examination are inconclusive, the doctor will prefer a breast MRI. It depicts your condition and viewpoint from that perspective. The primary diagnostic tool for determining whether a suspected area is carcinogenic is a biopsy. Thankfully, 80% of women who undergo a breast biopsy do not have a malignant growth.

The classification of breast cancer benefits greatly from machine learning. There is numerous diagnosis procedures, which are illustrated by the photos presented above. Machine learning is used to classify these types of diagnostic images (Kwekha-Rashid et al., 2021). AI includes the subfield of machine learning. Many developers utilize machine learning to improve the performance of their models by retraining them. The linear data is processed using machine learning (Sreehari & Ghantasala, 2019). Machine learning produces better results when the data is small, but when the data is too large, it does not. The model is trained using one of three main types of machine learning. Machine learning under supervision uses known data and the supervisor's assistance to complete tasks (Pradeep Ghantasala et al., 2022). Machine learning that is not under supervision is called unsupervised. Less machine learning reinforcement is used. These algorithms pull the most relevant data from prior knowledge to make precise decisions (Sharma & Batra, 2020).

Machine learning has a subfield called deep learning. Deep learning is an unsupervised method that gains knowledge from data. The data could be unlabeled or unstructured (Reddy et al., 2022). Deep neural networks are referred to as such if they include more than two hidden layers. In essence, the input layer is on the top, while the output layer is on the bottom (Krishna et al., 2019). When compared to a neural network, the intermediate layer, known as the hidden layer, has more layers. Neuron refers to the node that contains the layer. Deep learning differs from machine learning in that it is more likely to achieve its aim than machine learning is. Convolution Neural Network is utilized to classify the breast cancer dataset (Sharma et al., 2021). To classify the photos, a convolutional neural network is employed (Patan et al., 2020). The dataset of breast cancer picture inputs is used. The photos are provided to CNN along with the corresponding weights as input. To reduce mistake and improve performance, the weights are changed. Convolution layer, pooling layer,

ReLU layer, and fully connected layer are just a few of the many layers that make up CNN (Sharma, 2019). A feature map is used in the convolution layer to extract the given image's features and compress the original image. The image's dimensions are decreased by using a pooling layer (Ghantasala et al., 2020b). ReLU layer is employed as an activation function, determining whether the value of the activation function falls within a specified range. The model's final layer is the fully connected layer. It aggregates the findings from all layers and uses the softmax algorithm to assign probabilities to each output class.

# 2. Literature Review

The model was proposed by Rathi & Pareek (2016) and is based on a hybrid approach and machine learning. This method was put into practice using MRMR feature selection using four classifiers to determine the optimal outcomes. The four classifiers SVM, Naive Bays, Function tree, and End Meta were utilized by the author, and they were all compared. SVM was discovered to be an effective classifier to better understand results. Another hybrid model based on machine learning was proposed by Tahmooresi et al. (2018). That said, SVM was a good classifier that provided the highest accuracy of all. SVM, KNN, ANN, and decision trees had all been compared. It was applied to the blood and picture datasets. Aslan et al. (2018) suggested a machine learning model as a result, but they employed a different classifier. The author employed Extreme Learning Machine, SVM, KNN, and ANN as the classifier. To get better results, the classifier was slightly modified. That said, Extreme Learning Machine produced the best outcomes. Machine learning techniques have been compared by Bayrak et al. (2019). The Wisconsin breast cancer dataset and WEKA were used in the comparison. The author claims that SVM produced superior performance matrix findings. Deep learning techniques were created to address the issue with machine learning after that.

The model for supervised machine learning was put forth by Shravya et al. (2019). This study used classifiers such as Logistic Regression, SVM, and KNN. The dataset was acquired from the UCI repository, and performance tests were run on the findings. This indicates that SVM was a successful classifier, with 92.7% accuracy on the Python platform. Model-based SVM and Grid search were proposed by Deshwal & Sharma (2019). Prior to using SVM with Grid search, the author first applied the research on SVM. The author conducted comparisons to determine which was best. Comparatively speaking, the new model was constructed. Grid search was used to attain the higher accuracy. The deep learning-based model was proposed by Vijayan & Lekshmy (2019). The author concentrated on CNN for classification and Lloyd's technique for clustering. The suggested strategies succeeded in achieving the 96% accuracy. It employed histopathological pictures for the purpose of diagnosis. Deep learning and image processing were also explained in this paper.

It reached 81% accuracy by using CNN. However, accuracy increased to 89% when the photos were trained on a GPU. The deep residual neural network-based solution for IDC prediction was put forth by Chatterjee & Krishna (2019).The author used histopathology image data as her dataset. With an AUROC score of 0.9996, the author's accuracy was 99.29%. In order to select the model with the best accuracy, Nguyen et al. (2019) increased the dataset for the deep learning model. A survey on deep learning-based picture identification was conducted by Sornam et al. (2017). It emphasized the deep learning application's key characteristics. It provided the fundamental knowledge about every topic and demonstrated why deep learning algorithms produced better results. Using a diagnosis procedure like a mammography, Rampun et al. (2018) classified breast masses. Convolution neural networks were utilised for categorization. According to his research, a straightforward adjustment could produce improved results. It worked on the modified AlexNet. It made use of the activation function PReLu, which produced superior outcomes to Relu. The author focused on information management and decision support system for breast cancer results from the past and current. The author used the CBISDDSM dataset. The research based on the unsupervised feature extraction approach that was based on deep learning was proposed by Xiao et al. (2018). This method was used solely for feature extraction. The author also employed stacked auto-encoder, which essentially decreased the dimensions and produced more compact versions of the original data. The author employed an

SVM classifier. University of California obtained the analyzed data. The SVM-based model was proposed by Murugan (2010). This study involved numerous processes, including picture enhancement, segmentation, feature extraction, and application of the SVM classifier. For that model, the MIAS database was utilised. Noise reduction techniques such as median filtering and segmentation techniques such as thresholding were applied. The concept based on the k-nearest neighbours was proposed by Medjahed et al. (2015). The study used the Wisconsin Breast Cancer dataset to analyze performance in relation to distance. The author employed two distance formulas and obtained accuracy using each formula's distance. For the Euclidian distance, the accuracy was 98.70%, and for the Manhattan distance, it was 98.48. The Decision Tree Classifier Breast Cancer Model was proposed by Mathew (2019). Decision trees were used to implement the Wisconsin breast cancer dataset. The naive Bayes tree and rotating forest for classification were also discussed in the paper. The WEKA environment served as the subject of the study. Additionally, it examined bagging, boosting, adaptive boosting, and REPtree and shown accuracy. The model was proposed by Priyanka (2021) and is based on classifier augmentations. The author employed a dataset related to breast cancer and applied classification methods to it. Both with and without the feature selection procedure, the author used the five classifiers. These feature selection techniques mostly rely on correlation and data. Finally, it demonstrated how accurate these five classifiers were using feature selection methods and without them.

# 3. Deep learning's vast capabilities are revolutionizing the healthcare industry

In recent years, artificial intelligence (AI) and machine learning have grown significantly in acceptance. The situation changed even further with the start of the Covid-19 pandemic. We observed a swift digital transition and the adoption of disruptive technology throughout various industries throughout the crisis. One prospective industry that benefited greatly from the introduction of disruptive technologies was healthcare. Deep learning, machine learning, and AI have become crucial components of the industry. Deep learning has a significant impact on the healthcare industry and has made it possible to enhance patient monitoring and diagnosis. The most innovative uses of deep learning in healthcare are listed below.

### a) Drug Discovery

Deep learning plays a crucial role in discovering medication combinations. Disruptive technologies like AI, machine learning, and deep learning supported the development of vaccines and medications during the epidemic. Deep learning has the potential to simplify, accelerate, and reduce the complexity of the difficult work of drug discovery. Deep learning algorithms can generate a molecule with the desired qualities and anticipate pharmacological properties and drug-target interactions (Gadde et al., 2022). Genomic, clinical, and population data can be processed by deep learning algorithms with ease, and various toolkits can be used to find patterns in the data. Researchers can now define protein structures more quickly through molecular modelling and predictive analytics using machine learning and deep learning (Sharma, 2019).

### b) Medical Imaging and Diagnostics

To make a diagnosis, deep learning models can decipher medical pictures like X-rays, MRI scans, CT scans, etc. In the medical photos, the algorithms can identify any risk and highlight irregularities (Kumari & Ghantasala, 2020). The detection of cancer makes heavy use of deep learning. Machine learning and deep learning were key enablers of the recent advancement in computer vision. Diseases are more quickly diagnosed by medical imaging, making treatment simpler.

### c) Clinical Trials Made Easier

Clinical studies are difficult and costly. Scientists can pool participants from many data points and sources using machine learning and deep learning to do predictive analytics to find possible candidates for clinical

trials (Rupa et al., 2022). Deep learning will also make it possible to continuously monitor these trials while minimizing human mistake and interference.

### d) Personalized Therapy

Deep learning models make it simpler to examine patient health information, medical records, critical symptoms, test findings, and other data. As a result, this makes it possible for medical professionals to comprehend each patient and offer them a customized course of treatment. These innovative technologies make it possible to identify numerous, effective therapy alternatives for various patients (Ghantasala et al., 2021d). Machine learning models can employ deep neural networks to identify impending health issues or hazards and deliver particular medications or treatments with real-time data collecting from linked devices (Reddy et al., 2021).

### e) Improved patient monitoring and health records

Both organized and unstructured data from the worlds of medicine and healthcare can be processed and analyzed using deep learning and machine learning models (Ghantasala et al., 2022). Manually classifying documents and keeping up-to-date medical records may become challenging. In order to keep smart health records, machine learning and its subset deep learning can be applied. Deep learning can assist in intelligently monitoring the patients and predicting hazards because of the development of telemedicine, wearables, and remote patient monitoring. There is now a wealth of real-time health data available.

### f) Fraud detection and healthcare

Deep learning is effective at detecting insurance fraud and foreseeing potential problems (Mandal & Ghantasala, 2019 ). Deep learning gives health insurance providers another benefit because the models can forecast future trends and behaviour and recommend intelligent insurance policies to their customers.

### g) NLP and deep learning

Deep learning methods are used in natural language processing (NLP) for classification and identification (Mandal et al., 2020). These two technologies can be used to categorize and identify health data, as well as to create voice and chatbots. Chatbots are essential in the present telemedicine context. It facilitates quicker and simpler communication with patients. Additionally, these chatbots were used to promote Covid-19 and respond to important questions

## 4. Conclusion

Given that breast cancer is the most common and dangerous disease, detecting it is a difficult task. There is reduced possibility to recover from breast cancer, which is increasing annually. Deep learning and machine learning approaches are utilized to diagnose breast cancer. According to past studies, machine learning algorithms produce superior outcomes in their particular field. The earlier study was carried out using numerous machine learning approaches, with modest improvement and Increasing the dataset will improve performance. However, it is determined that machine learning performs better on linear data. From earlier studies, it is also inferred that the system will malfunction when the data is in the form of images. An original method is employed to address the issue with machine learning techniques. Data science regularly uses the freshly discovered deep learning technique. CNN, a deep learning-based technique, is employed for the categorization of the breast cancer picture data. CNN mostly uses the picture dataset. The previous study also came to the conclusion that CNN performs better than machine learning methods.

# References


- Aslan, M. F., Celik, Y., Sabancı, K., & Durdu, A. (2018). Breast cancer diagnosis by different machine learning methods using blood analysis data. International Journal of Intelligent Systems and Applications in Engineering.
- Bayrak, E. A., Kırcı, P., & Ensari, T. (2019, April). Comparison of machine learning methods for breast cancer diagnosis. In 2019 Scientific meeting on electrical-electronics & biomedical engineering and computer science (EBBT) (pp. 1-3). IEEE.
- Bhowmik, C., Ghantasala, G. P., & AnuRadha, R. (2021). A Comparison of Various Data Mining Algorithms to Distinguish Mammogram Calcification Using Computer-Aided Testing Tools. In Proceedings of the Second International Conference on Information Management and Machine Intelligence (pp. 537-546). Springer, Singapore.
- CADe, M. (2020). CADx for Identifying Microcalcification Using Support Vector Machine. Journal of Communication Engineering & Systems, 10(2), 9-16p.
- Chandana, P., Ghantasala, G. P., Jeny, J. R. V., Sekaran, K., Deepika, N., Nam, Y., & Kadry, S. (2020). An effective identification of crop diseases using faster region based convolutional neural network and expert systems. International Journal of Electrical and Computer Engineering (IJECE), 10(6), 6531-6540.
- Chatterjee, C. C., & Krishna, G. (2019, September). A novel method for IDC prediction in breast cancer histopathology images using deep residual neural networks. In 2019 2nd International Conference on Intelligent Communication and Computational Techniques (ICCT) (pp. 95-100). IEEE.
- Deshwal, V., & Sharma, M. (2019). Breast Cancer Detection using SVM Classifier with Grid Search Technique. International Journal of Computer Applications, 975, 8887.
- Gadde, S. S., Anand, D., Sasidhar Babu, N., Pujitha, B. V., Sai Reethi, M., & Pradeep Ghantasala, G. S. (2022). Performance Prediction of Students Using Machine Learning Algorithms. In Applications of Computational Methods in Manufacturing and Product Design (pp. 405-411). Springer, Singapore.
- Ghantasala, G. P., & Kumari, N. V. (2021). Breast Cancer Treatment Using Automated Robot Support Technology For Mri Breast Biopsy. INTERNATIONAL JOURNAL OF EDUCATION, SOCIAL SCIENCES AND LINGUISTICS, 1(2), 235-242.
- Ghantasala, G. P., & Kumari, N. V. (2021a). Identification of Normal and Abnormal Mammographic Images Using Deep Neural Network. Asian Journal For Convergence In Technology (AJCT), 7(1), 71-74.
- Ghantasala, G. P., Kallam, S., Kumari, N. V., & Patan, R. (2020a, March). Texture Recognization and Image Smoothing for Microcalcification and Mass Detection in Abnormal Region. In 2020 International Conference on Computer Science, Engineering and Applications (ICCSEA) (pp. 1-6). IEEE.
- Ghantasala, G. P., Kumari, N. V., & Patan, R. (2021d). Cancer prediction and diagnosis hinged on HCML in IOMT environment. In Machine Learning and the Internet of Medical Things in Healthcare (pp. 179-207). Academic Press.
- Ghantasala, G. P., Rao, D. N., & Mandal, K. (2021b). MACHINE LEARNING ALGORITHMS BASED BREAST CANCER PREDICTION MODEL. Journal of Cardiovascular Disease Research, 12(4), 50-56.
- Ghantasala, G. P., Reddy, A. R., & Arvindhan, M. (2021c). Prediction of Coronavirus (COVID-19) Disease Health Monitoring with Clinical Support System and Its Objectives. In Machine Learning and Analytics in Healthcare Systems (pp. 237-260). CRC Press.
- Ghantasala, G. P., Reddy, A. R., & Ayyappa, R. M. K. (2022). Protecting Patient Data with 2F-Authentication. Cognitive Intelligence and Big Data in Healthcare, 169.

- Ghantasala, G. P., Reddy, A., Peyyala, S., & Rao, D. N. (2021a). Breast Cancer Prediction In Virtue Of Big Data Analytics. INTERNATIONAL JOURNAL OF EDUCATION, SOCIAL SCIENCES AND LINGUISTICS, 1(1), 130-136.
- Ghantasala, G. P., Tanuja, B., Teja, G. S., & Abhilash, A. S. (2020b). Feature Extraction and Evaluation of Colon Cancer using PCA, LDA and Gene Expression. Forest, 10(98), 99.
- Kishore, D. R., Syeda, N., Suneetha, D., Kumari, C. S., & Ghantasala, G. P. (2021). Multi Scale Image Fusion through Laplacian Pyramid and Deep Learning on Thermal Images. Annals of the Romanian Society for Cell Biology, 3728-3734.
- Krishna, N. M., Sekaran, K., Vamsi, A. V. N., Ghantasala, G. P., Chandana, P., Kadry, S., ... & Damaševičius, R. (2019). An efficient mixture model approach in brain-machine interface systems for extracting the psychological status of mentally impaired persons using EEG signals. IEEE Access, 7, 77905-77914.
- Kumari, N. V., & Ghantasala, G. P. (2020). Support Vector Machine Based Supervised Machine Learning Algorithm for Finding ROC and LDA Region. Journal of Operating Systems Development & Trends, 7(1), 26-33.
- Kwekha-Rashid, A. S., Abduljabbar, H. N., & Alhayani, B. (2021). Coronavirus disease (COVID-19) cases analysis using machine-learning applications. Applied Nanoscience, 1-13.
- Mandal, K., & Ghantasala, G. P. (2019). A complete survey on technological challenges of iot in security and privacy. Int. J. Recent Technol. Eng., 7(6S4), 332-334.
- Mandal, K., Ghantasala, G. P., Khan, F., Sathiyaraj, R., & Balamurugan, B. (2020). Futurity of Translation Algorithms for Neural Machine Translation (NMT) and Its Vision. In Natural Language Processing in Artificial Intelligence (pp. 53-95). Apple Academic Press.
- Mathew, T. E. (2019). Simple and ensemble decision tree classifier based detection of breast cancer. International Journal of Scientific & Technology Research, 8(11), 1628-1637.
- Medjahed, S. A., Saadi, T. A., & Benyettou, A. (2015). Urinary system diseases diagnosis using machine learning techniques. International Journal of Intelligent Systems and Applications, 7(5), 1.
- Murugan, B. S. (2010). Classification of Breast Cancer Using SVM Classifier Technique. International Journal of Advanced Research in Computer Science, 1(4).
- Nguyen, C. P., Vo, A. H., & Nguyen, B. T. (2019, September). Breast cancer histology image classification using deep learning. In 2019 19th international symposium on communications and information technologies (ISCIT) (pp. 366-370). IEEE.
- Nozari, H., & Sadeghi, M. E. (2021). Artificial intelligence and Machine Learning for Real-world problems (A survey). International Journal of Innovation in Engineering, 1(3), 38-47.
- Nozari, H., Szmelter-Jarosz, A., & Ghahremani-Nahr, J. (2022). Analysis of the Challenges of Artificial Intelligence of Things (AIoT) for the Smart Supply Chain (Case Study: FMCG Industries). Sensors, 22(8), 2931.
- Patan, R., Ghantasala, G. P., Sekaran, R., Gupta, D., & Ramachandran, M. (2020). Smart healthcare and quality of service in IoT using grey filter convolutional based cyber physical system. Sustainable Cities and Society, 59, 102141.
- Pradeep Ghantasala, G. S., Nageswara Rao, D., & Patan, R. (2022). Recognition of Dubious Tissue by Using Supervised Machine Learning Strategy. In Applications of Computational Methods in Manufacturing and Product Design (pp. 395-404). Springer, Singapore.
- Priyanka, K. S. (2021). A review paper on breast cancer detection using deep learning. In IOP conference series: materials science and engineering (Vol. 1022, No. 1, p. 012071). IOP Publishing.

- Rampun, A., Scotney, B. W., Morrow, P. J., & Wang, H. (2018, September). Breast mass classification in mammograms using ensemble convolutional neural networks. In 2018 IEEE 20th International Conference on e-Health Networking, Applications and Services (Healthcom) (pp. 1-6). IEEE.
- Rathi, M., & Pareek, V. (2016). Hybrid approach to predict breast cancer using machine learning techniques. International Journal of Computer Science Engineering, 5(3), 125-136.
- Reddy, A. R., Ghantasala, G. S., Patan, R., Manikandan, R., & Kallam, S. (2021). Smart Assistance of Elderly Individuals in Emergency Situations at Home. In Internet of Medical Things (pp. 95-115). Springer, Cham.
- Reddy, A., Maheswari, M. U., Viswanathan, A., & Vikram, G. (2022). Using Support Vector Machine For Classification And Feature Extraction Of Spam In Email. International Journal of Innovation in Engineering, 2(2), 26-32.
- Rupa, C., MidhunChakkarvarthy, D., Patan, R., Prakash, A. B., & Pradeep, G. G. (2022). Knowledge engineering–based DApp using blockchain technology for protract medical certificates privacy. IET Communications.
- Sharma, O. (2019, February). A new activation function for deep neural network. In 2019 international conference on machine learning, big data, cloud and parallel computing (COMITCon) (pp. 84-86). IEEE.
- Sharma, O. (2019, February). Deep challenges associated with deep learning. In 2019 international conference on machine learning, big data, cloud and parallel computing (COMITCon) (pp. 72-75). IEEE.
- Sharma, O. (2019, November). A Novel Activation Function in Convolutional Neural Network for Image Classification in Deep Learning. In International Conference on Recent Developments in Science, Engineering and Technology (pp. 120-130). Springer, Singapore.
- Sharma, O., & Batra, N. (2020). Optimizing Text Data in Deep Learning: An Experimental Approach. In Big Data, IoT, and Machine Learning (pp. 133-150). CRC Press.
- Sharma, R., Mehta, K., & Sharma, O. (2021, December). Exploring Deep Learning to Determine the Optimal Environment for Stock Prediction Analysis. In 2021 International Conference on Computational Performance Evaluation (ComPE) (pp. 148-152). IEEE.
- Shravya, C., Pravalika, K., & Subhani, S. (2019). Prediction of breast cancer using supervised machine learning techniques. International Journal of Innovative Technology and Exploring Engineering (IJITEE), 8(6), 1106-1110.
- Sornam, M., Muthusubash, K., & Vanitha, V. (2017, December). A survey on image classification and activity recognition using deep convolutional neural network architecture. In 2017 ninth international conference on advanced computing (ICoAC) (pp. 121-126). IEEE.
- Sreehari, E., & Ghantasala, P. G. (2019). Climate Changes Prediction Using Simple Linear Regression. Journal of Computational and Theoretical Nanoscience, 16(2), 655-658.
- Tahmooresi, M., Afshar, A., Rad, B. B., Nowshath, K. B., & Bamiah, M. A. (2018). Early detection of breast cancer using machine learning techniques. Journal of Telecommunication, Electronic and Computer Engineering (JTEC), 10(3-2), 21-27.
- Vijayan, V. S., & Lekshmy, P. L. (2019). Deep learning based prediction of breast cancer in histopathological images. International Journal of Engineering Research & Technology (IJERT), 2278-0181.
- Xiao, Y., Wu, J., Lin, Z., & Zhao, X. (2018, July). Breast cancer diagnosis using an unsupervised feature extraction algorithm based on deep learning. In 2018 37th Chinese Control Conference (CCC) (pp. 9428-9433). IEEE.