International Journal of Research (IJR)
e-ISSN: 2348-6848
p-ISSN: 2348-795X
Vol. 9 Issue 10
October 2022

# Early Prediction of Breast Cancer Disease Using Support Vector Machine and Decision Tree Algorithm

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## ABSTRACT

Cancer detection and diagnosis is one ofthe most important areas of research in medical field. Neural networks have been used for medical sciences by many researchers, for different classes of cancer. Different algorithms of neural networks have been used for cancer detection. For early and efficient diagnosis of breast cancer more and more techniques are being developed. Thefeed forward back propagation neural network is one of famous approaches in neural network. It is mostly used in many medical applications and the classification of datasetinto respective categories such as for the education, marketing and network security. This architecture has generated a large class of network types with many training methods and different topologies. In this dissertation work we present the feed forward neural networkclassifier for the breast cancer detection and improved the accuracy rate over the previous approach.

**Keywords**:- Health care, Breast cancer, Classification, Neural network, Feed forward neural network, Support vector machine, Performance parameter.

## INTRODUCTION

Breast cancer is a major public health concern around the world, where its prevalence rate is the second-highest rate for women (excluding lung cancer) among all forms of cancer. The study of histopathological images remains the most commonly used tool for diagnosing and grading breast cancer, even with the substantial advances in medical science [2]. Early diagnosis can dramatically improve the effectiveness of therapy. The symptoms and signs of breast cancer are numerous, and the diagnosis encompasses physical analysis, mammography, and confirmed by core needle biopsy tissue (CNB) from the suspicious breast area. The sample tissue extracted from the CNB process demonstrates the cancerous cells and the grade of cancer associated with them. Pathologists typically look for certain characteristics that can help them predict disease prognosis during the visual inspection of the biopsy specimen of the tissue.

***Received***: *19 Sept. 2022*
***Revised***: *4 Oct. 2022*
***Final Accepted for publication***: *5 Oct 2022*

## BREAST CANCER

Breast cancer is the most diagnosed cancer worldwide. According to [3], that more than a million women have breast cancer each year and 400,000 of those cases lead to death. This fatal disease not only affects emerging countries but also developed countries. To find a cure, it is important to correctly diagnose the disease and very quickly and treat it based on the type of symptoms that have arisen. Generally, the most effective approach suggested by radiologists for this disease is medical images.

## NEURAL NETWORK

McCulloch and Pits proposed a binary threshold unit as a computational model for artificial neurons. The ANN is the duplication of an animal's central point nervous organism deliberately designed to meet the assistance of machine learning for pattern recognition. The neural network is a three-layer demonstration as shown in below figure that diverts the input and progression it to generate output. Being user needy for its design ANN has no single depiction. In this mode, the neurons are trained to fire in an exacting manner. In case if input pattern does not bear a resemblance to the trained list of patterns, dismissal rules take the resolution of firing or holding the inputs. In an explicit circumstance, BPNN's output matches Bayesian Posterior Probabilities. Statistical of samples (m) is represented in an adequate way to order prospect samples in the methodology developed for W number of weights and N number of nodes.

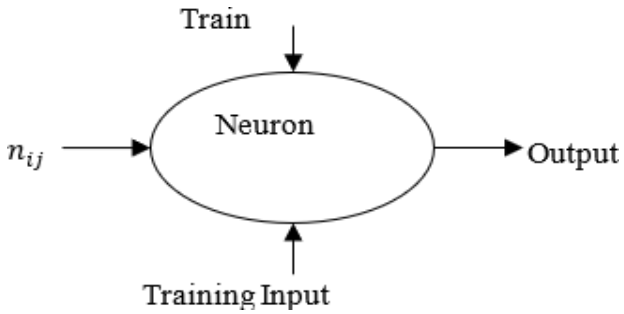


**Figure 1:** Representation of single neuron.

They are utilizing a feed-forward neural network, which processes signals in just one direction, from input to output. There are no feedback loops set up at any layer, and the output does not affect

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the same layer. This design is used in the majority of pattern recognition investigations. Tocreate the adequate response of input signals, the teaching method of a neural network gathers data from an external source (supervised learning). Feed-forward neural networks are trained using Back Propagation Neural Networks (BPNN). In feature space, it produces complex classification boundaries. In some cases, the output of BPNN resembles Bayesian Posterior Probabilities. These requirements, as well as the choice of parameters such as training dataset, hidden layer nodes, and activation functions, are required to ensure low error performance for a specific collection of features.

## CONVOLUTIONAL NEURAL NETWORK

In past few years deep learning methods, convolutional neural network (CNN), that can extract hierarchical features from image data without the manual selection, which is also called objective features, have been successfully applied with a great improvement on accuracies in many applications, such as image recognition, speech recognition, and natural language processing [4]. A deep learning (DL) or hierarchical learning classifier is a subset of machine learning that uses networks to simulate humanlike deciding supported the layers utilized in ANN. Unlike other machine learning techniques discussed until now, DL classifiers don't need features selection and extraction step as they adaptively learn the acceptable features extraction process from the input file with respect to the target output [5]. This is taken into account an enormous advantage for DL classifiers because the features selection and extraction step is challenging in most cases. Fora picture classification problem, the DL classifier needs three things to figure properly: an outsized number of labeled images, neural network structure with many layers, and high computational power. It can reach high classification accuracy. The most common sort of DL architecture wont to analyze images is Convolution Neural Network (CNN). Different types of CNN were proposed recently to deal with carcinoma detection and diagnosis using mammograms problem.

To overcome the matter of over fitting in machine learning techniques like DL and CNN, data augmentation techniques were wont to generate artificial data by applying several transformations techniques to the particular data like flipping, rotations, jittering, and random scaling to the particular data. Data augmentation may be a very powerful method for overcoming over fitting. Thee augmented data represents a more complete set of knowledge points. This will minimize the variance between the training and validation sets and any future testing sets. Data augmentation

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has been used in many studies alongside DL and CNN [6].

## LITERATURE REVIEW

BC (Breast Cancer) is the most common type of cancer found in women, which are categorized based on the nature of affected cells. The three significant parts of the breast are connective tissue, ducts and lobules. Most of the BC found in either ducts or lobules and common type ofBC are Invasive Lobular Carcinoma and IDC. Here we mention rich literature survey for breast cancer diagnosis using different techniques [9] Breast cancer is one of the most threatening diseases among women world-wide because ofits painful treatment process which provides a temporary cure but becomes fatal in most cases. It is a complex health problem which possesses a high mortality rate. But the good news is that it iscompletely curable if diagnosed during the early stage. Breast cancer is caused due to the uncontrolled multiplication of abnormal breast cells that forms a tumor in the breast area. The tumor could be either benign (non-cancerous) or malignant (cancerous) one. The malignant cells may spread from the original tumor area to neighboring lymph nodes or to other distant parts of the body, in which case it is called metastasis. The symptoms of breast cancer may include pain in the breast, swelling of the breast, thickening of the breast tissues, dimpling of the breast or as alump in the breast or the armpit. Many types of research have been made to predict breast cancer accurately. This paper reviews and compares three different models using the SVM (Support Vector Machine) method that is tried and tested to detect the presence of breast cancer with greater accuracy. Later in this study, a novel system that employs Artificial Neural Network and Multi-Level Support Vector Machine model is employed for the detection of breast cancer. The proposed system employs the mini-MIAS database. The accuracy of the intelligent system has proved to be better than the other approaches that have been studied.Breast cancer is the second leading cause of death among a large number of women worldwide. It may be challenging for radiologists to diagnose and treat breast cancer.

[11] To overcome the two class imbalance problem among breast cancer diagnosis, a hybrid method by combining principal component analysis (PCA) and boosted C5.0 decision tree algorithm with penalty factor is proposed to address this issue. PCA is used to reduce the dimension of feature subset. The boosted C5.0 decision tree algorithm is utilized as an ensemble

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classifier for classification. Penalty factor is used to optimize the classification result. To demonstrate the efficiency of the proposed method, it is implemented on biased-representative breast cancer datasets from the University of California Irvine(UCI) machine learning repository. Given the experimental results and further analysis, our proposal is a promising method for breast cancer and can be used as an alternative method in class imbalance learning.

[12] Brain Cancer is one of the most threatening disease today. It caused due to the uncontrolled growth of unhealthy cells in the brain that could be either cancerous or non-cancerous. In today's world a brain tumor are not only a life threatening disease but is also the prominent reason behind numerous deaths. Magnetic Resonance Imaging (MRI) is mostly used in brain tumor analysis. In this work, a new deep learning algorithm that is based on CNN with SVM is presented for efficient and automatic segmentation of brain tumor. The steps involved in the processing include preprocessing of the input image, extracting the important features, performing image classification, and finally segmenting the tumor in the brain.

[13] Breast Cancer (BC) is the common type of cancer found in women which is caused due to the abnormal growth of cells in the breast. An early BC detection helps to increase the survival rate of the patient and 80% BC type was Invasive Ductal Carcinoma (IDC) .In this work, a deep learning-based IDC prediction model is proposed with multiple classifiers and CNN (Convolutional Neural Network). The developed deep learning method used a sequential Keras model like conv2D, Maxpooling2D, Dropout, Flatten and Dense. The multiple classifiers are LR (Logistic Regression), RF (Random Forest), K-NN (K-Nearest Neighbors), SVM (Support Vector Machine), Linear SVC, GNB (Gaussian NB) and DT (Decision Tree). The CNN model generated by using SkLearn, Keras and Tensor flow libraries, and results are organized by MatPlot libraries.

[14] With the advancements in computer technology, there is a rapid development of intelligent systems to understand the complex relationships in data to make predictions and classifications. Artificail Intelligence based framework is rapidly revolutionizing the healthcare industry. These intelligent systems are built with machine learning and deep learning based robust models for early diagnosis of diseases and demonstrates a promising supplementary diagnostic method for frontline clinical doctors and surgeons. Machine Learning and Deep Learning based systems can streamline and simplify the steps involved in diagnosis of diseases from clinical and image-baseddata, thus

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providing significant clinician support and workflow optimization. They mimic humancognition and are even capable of diagnosing diseases that cannot be diagnosed with human intelligence. This paper focuses on the survey of machine learning and deep learning applicationsin across 16 medical specialties, namely Dental medicine, Haematology, Surgery, Cardiology, Pulmonology, Orthopedics, Radiology, Oncology, General medicine, Psychiatry, Endocrinology, Neurology, Dermatology, Hepatology, Nephrology, Ophthalmology, and Drug discovery.

[15] Cancer is one of the most dangerous diseases to humans, and yet no permanent cure has been developed for it. Breast cancer is one of the most common cancer types. According to the National Breast Cancer foundation, in 2020 alone, more than 276,000 new cases of invasive breast cancer and more than 48,000 non-invasive cases were diagnosed in the US. To put these figures in perspective, 64% of these cases are diagnosed early in the disease's cycle, giving patients a 99% chance of survival. Artificial intelligence and machine learning have been used effectively in detection and treatment of several dangerous diseases, helping in early diagnosis and treatment, and thus increasing the patient's chance of survival. Deep learning has been designed to analyze the most important features affecting detection and treatment of serious diseases. For example, breast cancer can be detected using genes or histopathological imaging. Analysis at the genetic level is very expensive, so histopathological imaging is the most commonapproach used to detect breast cancer. In this research work, they systematically reviewedprevious work done on detection and treatment of breast cancer using genetic sequencing or histopathological imaging with the help of deep learning and machine learning

## PROBLEM STATEMEMNT

The World Health Organization (WHO) has defined 2 distinct but related strategies to promote the early detection of cancer: early diagnosis, which is the recognition of symptomatic cancer at an early stage, and screening, which is the identification of asymptomatic disease in a target population of apparently healthy individuals. Health planners, policymakers, and other stakeholders, including clinicians, educators, community members, and advocates, should be aware of the health system requirements, as well as overall costs of these approaches to breast cancer early detection, to make effective investments, plans, and policies.

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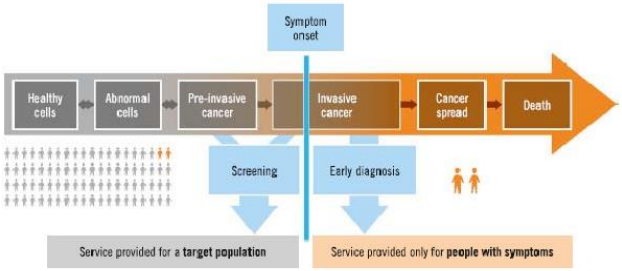


**Figure 3:** Distinguishing screening from early diagnosis is illustrated according to symptom onset.

## PROPOSED WORK

Breast cancer is the most common cancer in women. Breast cancer is the second leading cause of death among women. Breast cancer also developed in men, breast cancer in men is rare, an accounting for less than 1% of all breast cancers, only about 1 out of 1,000 men will get it at some point in their lives.. The main factors include the woman's age, hormones, and whether there is a higher risk of breast cancer in her family. Unsupervised learning algorithms begin with a model that receives unlabeled data and discovers hidden patterns or data groupings without providing any guidance or instructions. The most popular supervised learning algorithms include: linear regression, logistic regression, decision tree, support vector machine, k-nearest neighbor and neural networks. Linear regression establishes a relationship between independent and dependent variables, adjusting the best line and using estimated real values. To predict the probability of occurring an event by a discrete estimated value is called a Logistic regression. When dividing data into two or more homogeneous sets, based on independent variables is defined as Decision tree. The Support vector machine algorithm aims to find a hyperplane in an n-dimensional space (n-the number of resources) that distinctly classifies the data points. The K-nearest neighbor is a simple algorithm that stores all available cases and classifies them in new cases considering the closest distance to their k neighbors. The last three algorithms mentioned earlier are used in classification problems. A Neural network is said to learn supervised, if the desired output is already known. Neural networks are trained by processing examples, each of which containing a known input andoutput, forming probability-weighted associations between the two, which are stored within the data structure of the net itself.

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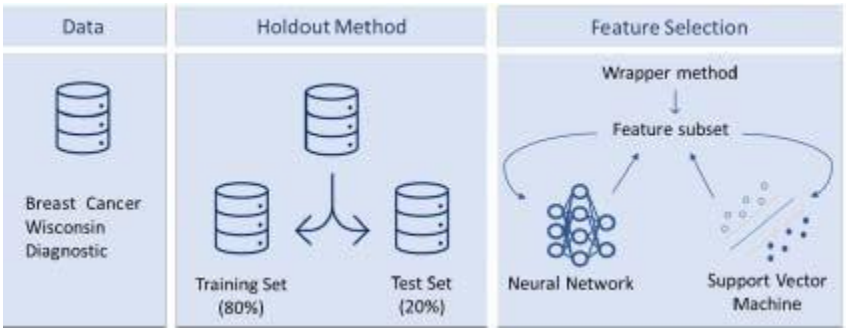


**Figure 4:** Steps to achieve the proposed aims.

## FEATURE EXTRACTION

Each well define object has some features or properties which helps us to identify that object easily. To automatically classify the objects, we need some features. Collection of these features are called features vector. For the identification of lung cancer, we need to be find such features from the image. In image processing there are three types of features, first is structural features, second is statistical texture features and third is spectral features. Structural features are also called binary features like area, centroid, perimeter, orientation, projection, aspect ratio and Eulernumber etc.

## SUPPORT VECTOR MACHINE

Support Vector Machine (SVM) is characterized by its simplicity and exibility to deal with a wide variety of classification problems. The objective of the SVM is to find a hyperplane that classifies the data points. In SVM, a data point is viewed as a n-dimensional vector (n features), and the goal is to separate such points with a (n-1)-dimensional hyperplane. This is a linear classifier. There are many hyperplanes that might classify the data, turjillo but the goal is to find the hyperplane that represents the largest separation between the two classes, maximizing the distance from the hyperplane to the nearest data point on each side. SVM can also be used for nonlinear separate functions through a kernel function. SVM has been widely used in theresearch of brain diseases and in the diagnosis of cancerous diseases, such as in the psychiatric context in order to diagnose neurological diseases (Alzheimer, schizophrenia and depression). Neuro-imaging analysis using SVM allows to study a large amount of cancer data, leading to the discovery of new drugs and a better understanding of genes originated in cancer. In addition, SVM has also been used to breast cancer diagnosis and classification [25].

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## PROPOSED WORK

Neural networks (NN) have been increasingly used to solve artificial intelligence problems. The diagnosis of breast cancer is an example where NN have been widely used. Neural networks are machine learning techniques that simulate the learning mechanism in biological organisms and are networks of interconnected artificial neurons. The main advantage of neural networks is that they are data-driven and do not require restrictive assumptions about the shape of the basic model. In addition to this advantage, NN allow detecting complex nonlinear relationships between independent and dependent variables and to identify all possible interactions between predictor variables, having the ability to store information on the network (memory capacity). In addition, NN can work with incomplete knowledge and in parallel processing. However, NN also have disadvantages, such as hardware dependency, the lack of determination of the appropriate network structure, more computational resources requirements and limited ability to identify possible casual relationships. In this research, the ANN is used to classify the breast cancer samples in the WBCD into either benign or malignant. ANN was used intensively in the diagnosis and classification of many medical conditions such as leukemia, prostate cancer, lung cancer, liver cancer and many others. There are various ANN architectures. However, one of the most widely used is the multilayer feed-forward neural network (FFNN) with a back-propagation learning algorithm. In FFNN, there are a number of parameters need to be tuned in order to obtain the best classification performance. These parameters include the number of hidden layers, the activation function, and the number of neurons, the learning rate, and the epochs. The number of hidden layer is set to one as usually single hidden layer is sufficient for various kinds of classification problem. Regarding the activation function, in fact, there are many options available. Hence, for this experiment, the sigmoid activation function is chosen. The rest of the FFNN hyper-parameters is tuned with the grid search optimization using 10-fold cross validation. The grid search algorithm traverses a given combination of parameters. Later, the parameters resulted in the best performance can be used to train the final model and tested using the test set. In grid search the performance of the model is verified using a statistical method called cross validation (CV). The cross validation divides the dataset into two parts, namely, training and validation. On each hyper-parameter combi-nation, the FFNN is trained and the accuracy is verified. Eventually, the model which produced the highest performance is used for the final classification test [26].

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## ALGORITHM

1. Calculate “d(x, xi)” i =1, 2, . . . .., n; where d denotes the Euclidean distance between the points.
2. Arrange the calculated n Euclidean distances in non-decreasing order.
3. Let k be a +ve integer, take the first k distances from this sorted list.
4. Find those k-points corresponding to these kdistances.
5. Let ki denotes the number of points belonging to the ith class among k points i.e. k 0
6. If ki¿kj i j then put x in class i.

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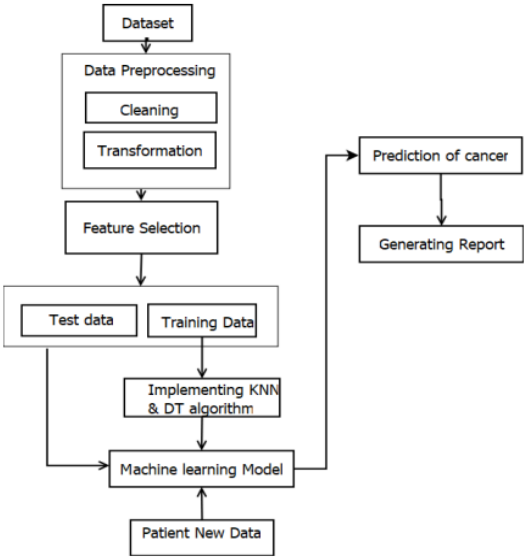


**Figure 5:** Feed forward neural network.

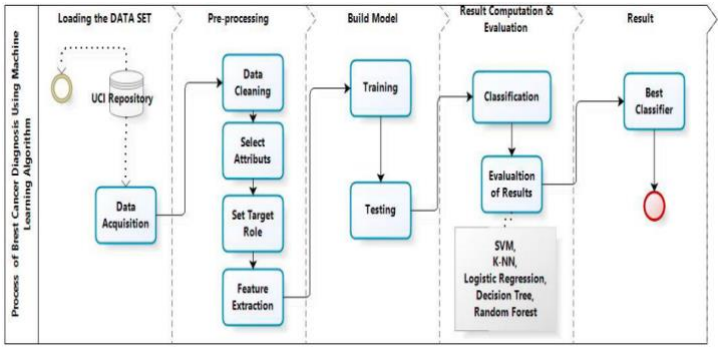


**Figure 6:** The above image shows the proposed work simulation block diagram.

## RESULT DISCUSSION

In this section, experimental process of we show that the comparative result analysis study for the detection of breast cancer using classification techniques. The mining of healthcare database is very critical issue. The healthcare data stored the information about medical diseases and patient's information. For the extraction of better information used data mining technique for the healthcare system. Here for the evaluation of performance parameter we used matlab software for the authenticity and effectiveness of results; results are measured with performance parameters like accuracy using existing and proposed techniques [27].

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## RESULT ANALYSIS

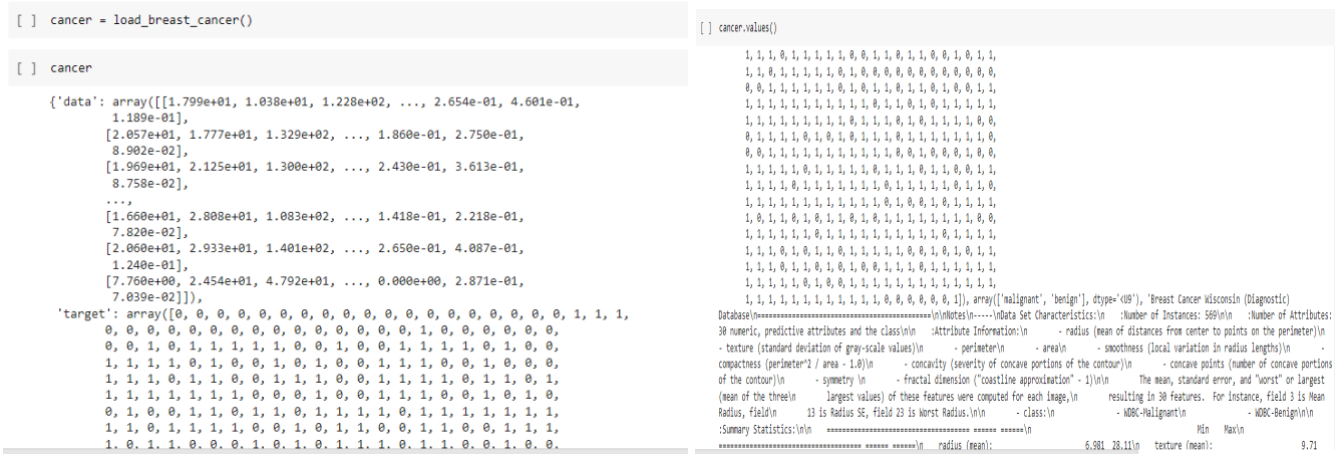


**Figure 6:** This picture represent code window for the experimental work.

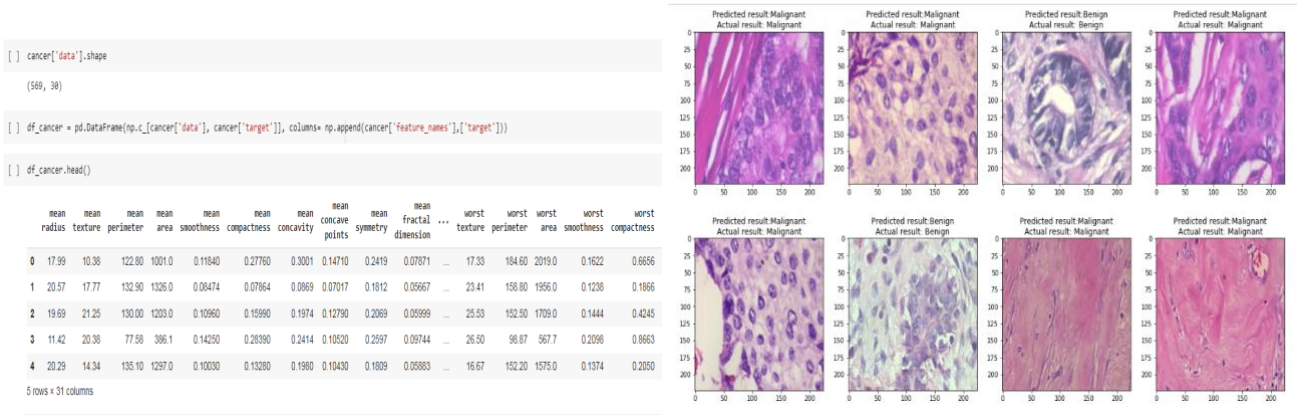


**Figure 7:** This picture represent graphical user interface window for the experimental work.

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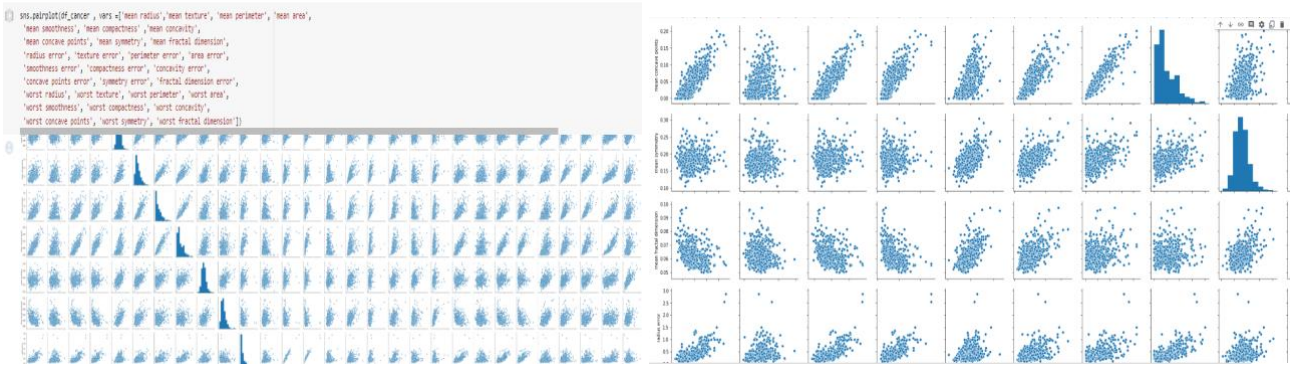


**Figure 8:** This picture represent input image for the experimental work using the support vector machines.

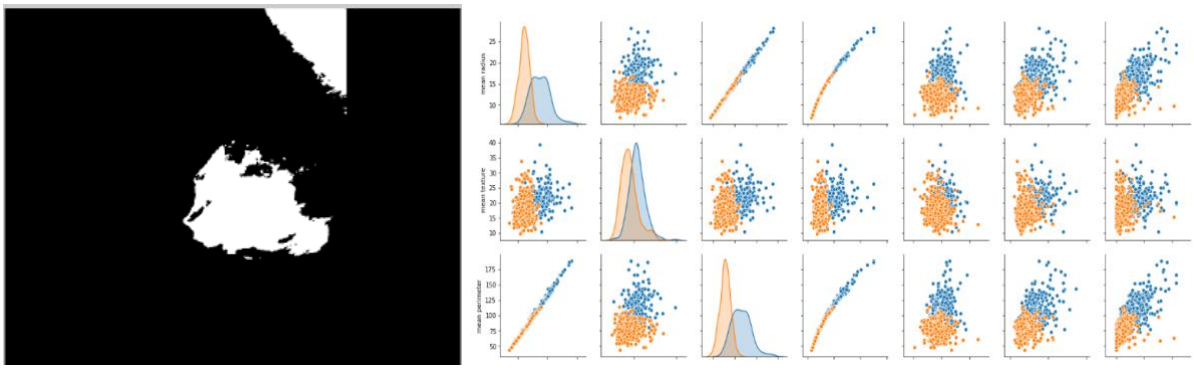

**Figure 9:** This picture represent mask image for the experimental work.

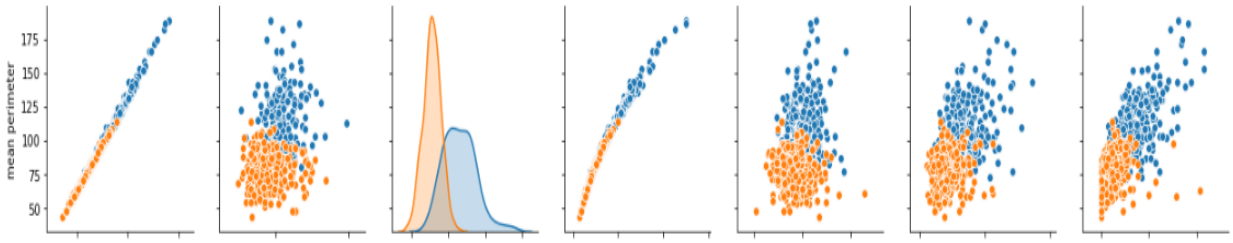


**Figure 10:** This picture represent neural network training window for the experimental work using the proposed techniques.

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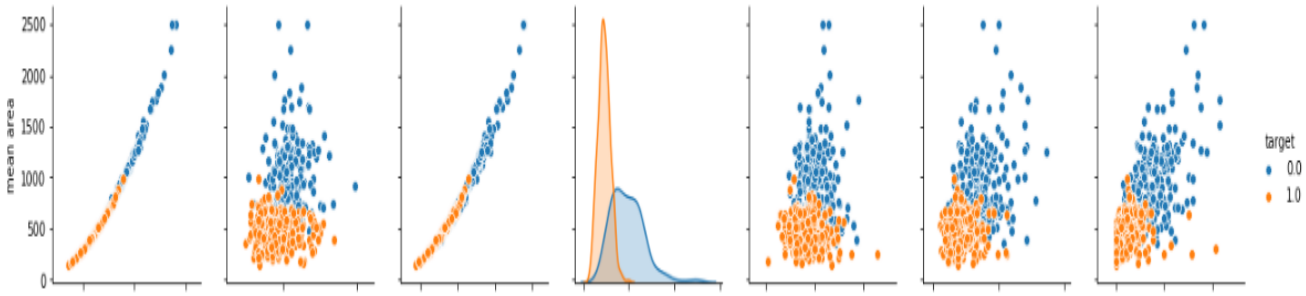


**Figure 11:** This picture represent neural network training window with iteration for the experimental work using the proposed techniques.

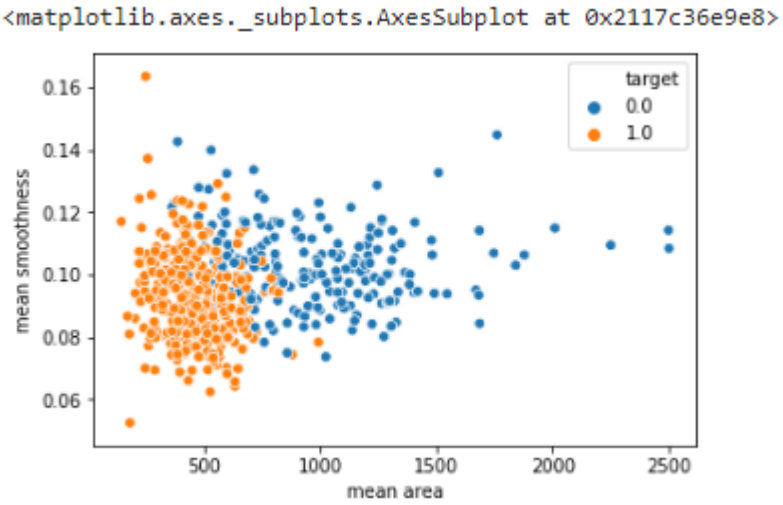


**Figure 12:** This picture represent accuracy after the experimental work using the feed forward neural network.

## COMPARATIVE PERFORMANCE EVALUATION

| Name of classification method | Accuracy |
|---|---|
| **Support Vector Machine** | **96.34** |
| **Feed Forward Neural Network** | **98.61** |

**Table 1:** The above table shows accuracy for the breast cancer detection between the previous and our approach.

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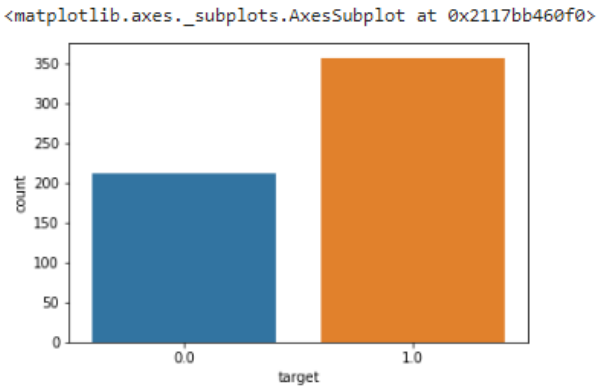


**Figure 13:** This picture represent accuracy for the breast cancer detection using the existing and present method.

# CONCLUSIONS

Cancer is a term used for a group of disorders associated with abnormal cell growth. The abnormal cells have the potential to spread to other parts of the body (metastasis). Cancer can develop in any part of the body; the most common types are prostate, lung and bronchus, breast and colorectal. Cancer is staged according to its extent at the time of diagnosis. Breast cancer is the second leading cause of death for women, so accurate early detection can help decreasebreast cancer mortality rates. Computer-aided detection allows radiologists to detect abnormalities efficiently. Medical images are sources of information relevant to the detectionand diagnosis of various diseases and abnormalities. Several modalities allow radiologists to study the internal structure, and these modalities have been met with great interest in several types of research. In some medical fields, each of these modalities is of considerable significance. An important factor that affects breast cancer mortality is the stage at diagnosis. Breast cancer detection at early stages relies on regular mammograms in women above a certain age or with a family history of breast cancer in developed countries. Among all the resources spent on breast cancer screening worldwide, only 5% is on screening in developing countries. Limited resources in these countries lead to far fewer mammograms and greater reliance onbreast self-examinations and clinical breast examinations. A challenge in CAD arises from the use of multiple steps for pre-processing, post-processing, data augmentation, etc., where the errorat each step of the algorithm produces a cumulative error that increases with each step.

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## FUTURE SCOPE

Neural networks are used in computer aided diagnosis to perform image classification tasks. This study analyzed the performance of two commonly used feed forward neural networks for classification of histopathology images of breast tissue. The field of computer vision is quickly evolving, with newer image classification techniques such as attention mechanisms using transformers can be used. In future we may use artificial intelligence techniques to improve the performance of an existing system.

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