

**How to Cite:**

Mohmed, M. H. A., & Rani, A. N. (2022). Prediction novelty implements breast cancer disease detection using machine learning techniques. *International Journal of Health Sciences*, 6(S2), 14953–14968. <https://doi.org/10.53730/ijhs.v6nS2.8963>

# Prediction novelty implements breast cancer disease detection using machine learning techniques

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**Abstract**--Cancer is one of the crucial causes of death for both men and women. All over the world, breast cancer is one of the leading causes of cancer deaths in women. The most effective way to reduce cancer death is to detect it earlier, but the detection of cancer in its early stages is not an easy process. As a result, many researchers focus on developing different breast cancer detection systems. In this paper, we have discussed various data mining approaches that have been utilized for breast cancer diagnosis and prognosis. We have proposed a breast cancer prediction framework consisting of four main modules: Data Collection, Data Preprocessing, Feature Selection, and Classification. Evaluation results are provided as well. The goal is to find the best combination of feature extraction algorithm and classification algorithm, which will improve the accuracy of the mammograms classification process. Cancer is one of the crucial causes of death for both men and women. All over the world, breast cancer is one of the leading causes of cancer deaths in women. The most effective way to reduce cancer death is to detect it earlier, but the detection of cancer in its early stages is not an easy process. As a result, many researchers focus on developing different breast cancer detection systems. In this paper, we have discussed various data mining approaches that have been utilized for breast cancer diagnosis and prognosis. We have proposed a breast cancer prediction framework consisting of four main modules: Data Collection, Data Preprocessing, Feature Selection, and Classification. Evaluation results are provided as well. The goal is to find the best combination of feature extraction algorithm and classification algorithm, which will improve the accuracy of the mammograms classification process. Cancer is one of the crucial causes of death for both men and women.

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**Keywords**---breast cancer, classification rules, machine learning, diagnosis, risk factor, prediction, feature selection.

## **Introduction**

Chest undermining advancement has become the key wellspring of death in ladies in made nations. The best strategy for reducing chest disease passing is

remembering it prior. The proposed method is used to determine the accuracy of the proposed algorithm for disease prediction using the Wisconsin data set of breast cancer disease. Cancer disease detection and prediction are determined using various other algorithms in data mining and clustering with non-clustering classification algorithms. the proposed Classification algorithms use the method with testing and training data set. [4].

The breast cancer disease survival rate is increase<sup>4</sup> rapid now with the help of detection methods also introduced by various researchers. Breast cancer is the most common disease in women. The death rate of breast cancer is not much higher in India and the world. 29% of women have died from the causes of last-stage breast cancer. So many issues generate due to feeding children and scissors problems, and critical medicine also generates this disease in women.

Breast cancer is two types defined by medical terms: benign tumors and malignant tumors. The first one, benign tumors, do not generate cancer cells in the human body. So it is not much more dangerous for women. The survival rate is very high in women. On the other hand, malignant tumors generate cancer cells in vessels, blood, also in tissues. [5]So malignant tumors are very harmful to women. If it is not diagnosed in the first stage, it will be very harmful and dangerous for women, especially those more than 50 years above women. The patient's record data includes doctors' prescription reports, medical tests, nurse notes, DRA regulations, pharma co vigilance reports, and critical view reports. Moreover, this data set is collated from a computer-aided system and generally cross-checks all parameters of breast cancer suffering patients. The machine learning approach is learning all data without any instruction by the programmer and learning automatically and setting as training and testing data for generating and improving algorithms' accuracy and efficiency. [6]

### **Breast cancer overview**

Breast cancer is related to women's disease for damaging body parts and generates penus in the body. After that, some body part of women is damaged very rapidly. The result of this disease is going to the death rate is very high in the case of cancer. [9] These categories are two main: benign tumor and the second one is ma malignant tumor. In both cases,s if the cell is cancerous, that means no chance<sup>4</sup> of a woman's life surviving. The cells of the body will damage shortly due to tumors. The blood vessels also suffer from this cancer disease. In India, every two minutes, one woman is diagnosed with breast cancer, and every nine-minute one women die due to breast cancer. Early detection and early prediction of disease of cancer patient's life save otherwise no option at all. [10]

### **Various symptoms are followed for breast cancer disease in women**

- High pulse rate increased.
- Blood pressure increases rapidly.
- Tumors detect in the body.
- Fever and another nervous disorder also.
- Hormone disbalance.
- Serous bacterial infection.

## Issues and challenges

The main issue of this breast cancer disease is not early diagnosis properly in women due to the last stage detect of the disease in the human body. The challenge is properly diagnosing the disease stage for a better outcome. The only way is machine learning approaches to determine the proper learning data set based on patient's record, medical reports, and who have suffered cancer. [11] The challenge of this study is to simulate disease prediction at an early stage. Data processing is full of problems for using data set re sampling and missing values removed.

## Data mining

Breast cancer is an invasive cancer disease and the second layer of death cause of women. The main objective of this research paper is to compare the data mining algorithms used to predict breast cancer disease in women with the help of the data mining algorithm result of prediction and detection. The c4.5 algorithms are used to better predict breast cancer disease prediction for women suffering very harmful and death aspect level chances increased. This research work is cross-section under the study period of 2018-2020. The Wisconsin breast cancer disease data set predicts and detects better results.

KDD is the process of discovering useful information of data from data sets. Data-mining is the application of a specific algorithm for gathering data sets. [12]

Problem definition: breast cancer is the prediction by using machine learning approaches.

Data exploration: it will be a simulation weka tool for converting in CSV file format and updating with proper coding and results.

Data preparation: data set is a must, with a testing and training set of 66% and 34 %.

## Related work

Various authors determine the systematic literature review represents the data mining and machine learning techniques for breast cancer disease prediction and detection using algorithm accuracy and efficiency representation. B. Nithya, V. Ilango, [1] Portrayal and batching are the most used techniques in data mining. Clustering strategies intend to eliminate information from an instructive file to discover social affairs or gatherings and portray the educational assortment. Abdelghani Bellaachia and Erhan Gauvin [2] state that the various c4.56 algorithms, the Naive Bayes algorithm, also worked for Breast cancer disease detection. The level of accuracy is 89 % using the data set from Kaggle .com. In [3], M. Lundin et al. have applied ANN to breast cancer disease detection using machine learning techniques. The data set is used as the sampling method. The ANN algorithm determines the accuracy rate is 89% for disease detection based on previous patients' records and set parameters values. In [4] Delen et al., the author states that the regression model is also used for comparison and analysis of previous ML-based algorithms for disease detection and prediction model representation.

AmitBhola. et al. [5] utilize the SEER information to think about three expectation models for identifying bosom malignancy. They have announced that the C4.5 calculation measured the percentile ratio is 87% of the accuracy of disease prediction of disease detection of breast cancer patients. Endo et al. completed the comparison of various data mining algorithms like k-means, random forest, and decision tree accuracy rate is 87% for detection of breast cancer disease. Kotsiantis et al. [7] the diagnosis and prognosis of breast cancer disease using WEKA tool with file CSV format. Machine learning is used only for specific data sets, not for generalizations. According to Rajesh et al. [8], the author state that the training and testing methods also worked for disease detection using ML-based algorithms with Jupiter navigator simulate tool.

### **Arrangement techniques**

Building precise and productive classifiers for huge information bases is one of the fundamental assignments of information mining and A.I. research. Building successful arrangement frameworks is one of the focal assignments of information mining. Various sorts of order procedures have been proposed in writing that incorporate Decision Trees, Naive-Bayesian strategies, Neural Networks, Logistic Regression, SVM and KNN, and so on

### **Breast Cancer**

The wild division of one specific cell, which prompts mass development, is considered growth that prompts disease. When the phones in the bosom start to develop strangely, which goes to growth, it is called bosom malignancy. Bosom malignant growth can begin from various pieces of the bosom. The bosom disease spreads to different body pieces when the malignancy cells get into the blood or the lymph hubs. Masses and miniature calcifications are early manifestations of bosom malignant growth [8].

### **Some of the risk factors of breast cancer are**

1. Age
2. Genetics
3. Dense breast tissue
4. Breast-feeding.
5. Body weight.
6. X-ray report.
7. High pulse rate.
8. Alcohol consumption etc.

### **Component determination**

This procedure can be applied to informational collections when there are simply two classes to be characterized. It orders information by isolating the information focuses starting with one class and then onto the next by building a hyper-plane. The chosen subset of provisions is controlled by learning and assessing a classifier utilizing just the factors remembered for the proposed Subset [21].

Filter: The effectiveness of chosen subset of provisions is controlled by utilizing just characteristic properties of the information [25] [21]. Classification:

### **Research methodology**

Raw Dataset - Data sets are collected from patient's data, medical records, DRA paper, pharma reports, nurses' reports, and medical test reports.

Dataset Collection -. The various patient records are considered breast cancer disease with reports and used as defined parameters.

Choice of Tools –Information Pre-preparing - WEKA apparatus can pre-measure the information in the numeric and ostensible (single) types. The comma isolated worth (.csv) is valuable for information examination yet needed to transform it to credit connection document design (.arff) for the WEKA instrument.

Testing and train method is used to determine the basic performance of paper design and level of accuracy determine along with Jupiter anaconda navigator simulate tool

Accuracy is measured by defining parameters based on data set values.

Sensitivity performance measure value is determined by simulating tool specificity is calculated by measured define values of patients record-based data set.

### **Proposed algorithm**

#### **Algorithm of M\_tree classifier**

```

Technique MY_MTree (x1, x2, ... ,xN; K; F)
/K – the quantity of groups an clusters.
/F- I,f,1,2,3,---nfilling factor
for ( i=1, i<N)
{
Ci=FindCentroid (centroids, xi, x2,x3,x4,x5--xn);
in the event that ( #Leaf [Ci] has F occasions)
in the event that (#we have k groups)
#put xi in Leaf [f.Ci]
else
#split Leaf [f.Ci]
else
#put xi in Leaf [f.Ci]
RecomputedCentroids (Leaf[f.Ci])
} //end for.

```

### Simulation analysis & result

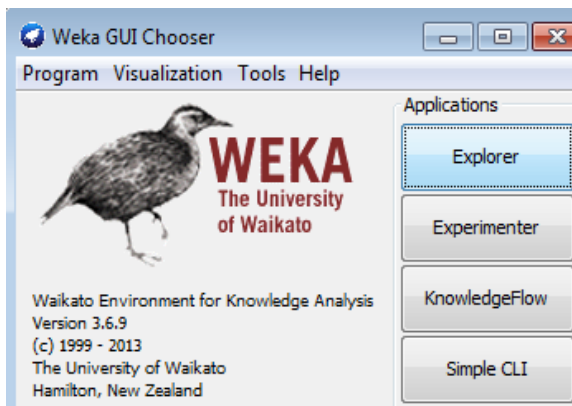


Fig 1: Implementation In Weka Simulate Tool

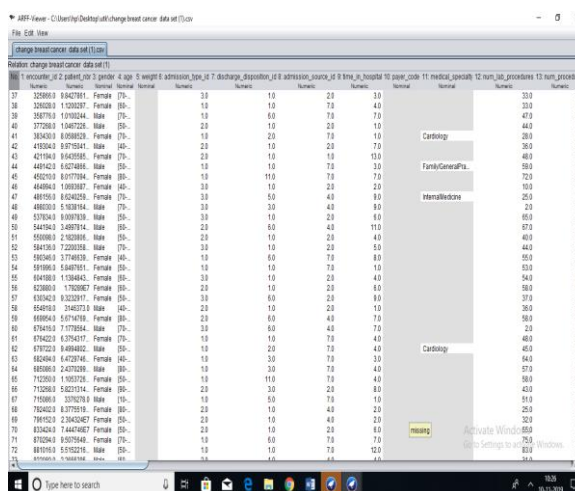


Fig 2: uploaded the data set in the simulation tool

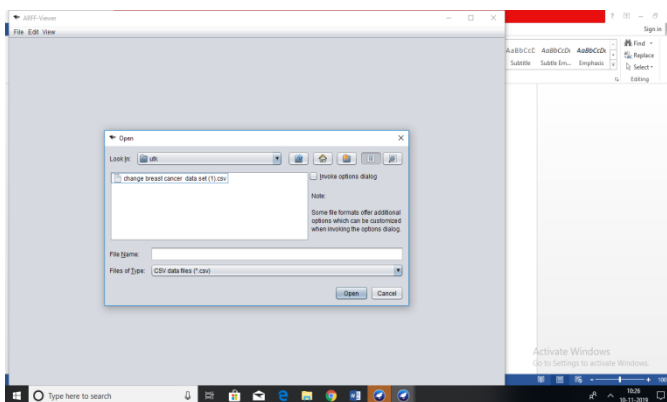


Fig 3 data set attributes in modified approaches

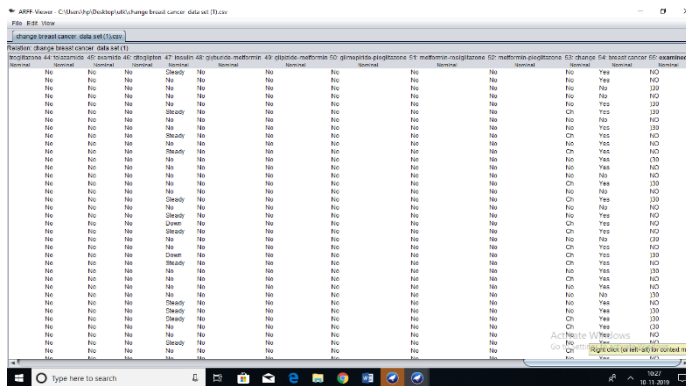


fig 4 date set in WEKA tool for counting attributes

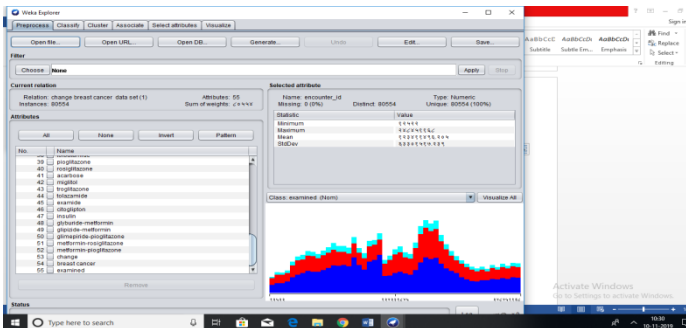


Fig 5 real data set in implement in PYCHARM simulation tool

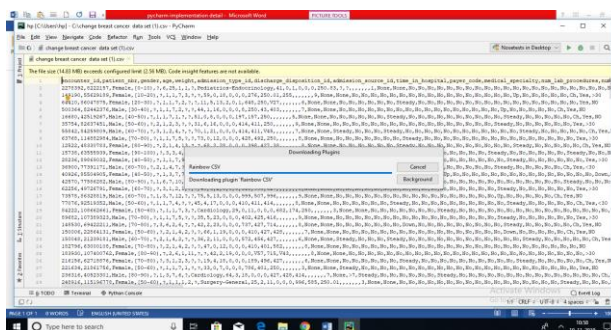


Fig 6 Pycharm simulation tool represents the data set

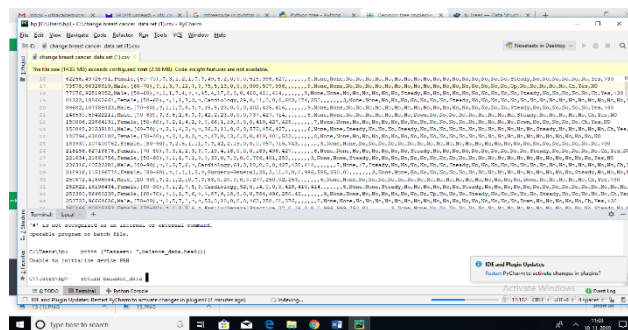


Figure 7: Output Result

**Result analysis**

Show the outcomes for order procedures applied on the Wisconsin Breast Cancer dataset in WEKA separately. Based on correlation over exactness and mistake rates, the arrangement strategies with the most noteworthy precision are given distinctive A.I. devices for this dataset. The figure examines the best characterization strategies applied to this dataset.

proposed model for breast cancer disease prediction model	sum of errors	accuracy	time of execution	iteration
M_tree proposed model	8.12	91.125	1.19	5

Table 1.1 Analysis report of M-tree model for breast cancer data set

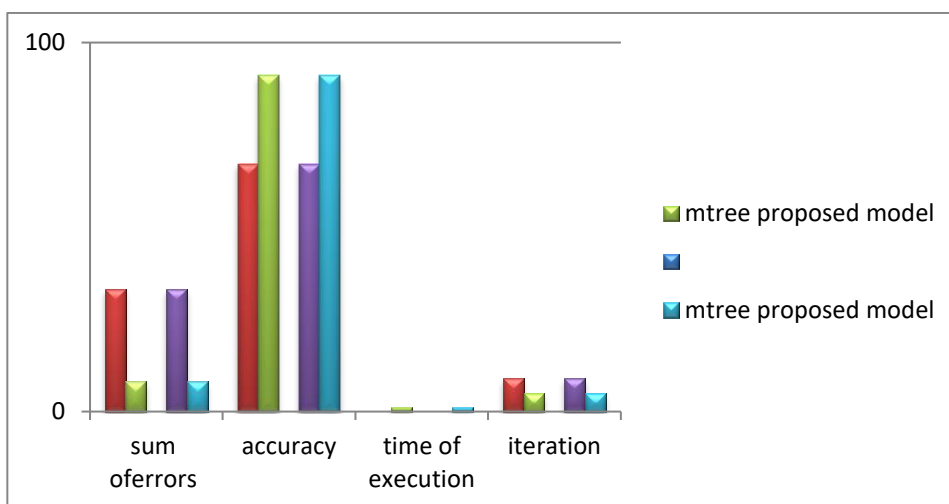


Fig 8 M-tree graph representation of analysis report

Factors	Sum of errors/ In corrected instances	Percentage of errors	%(accuracy)
M-tree classifier	69	8.999	92.125

Table 1.2 Assignment value using M-tree classifier

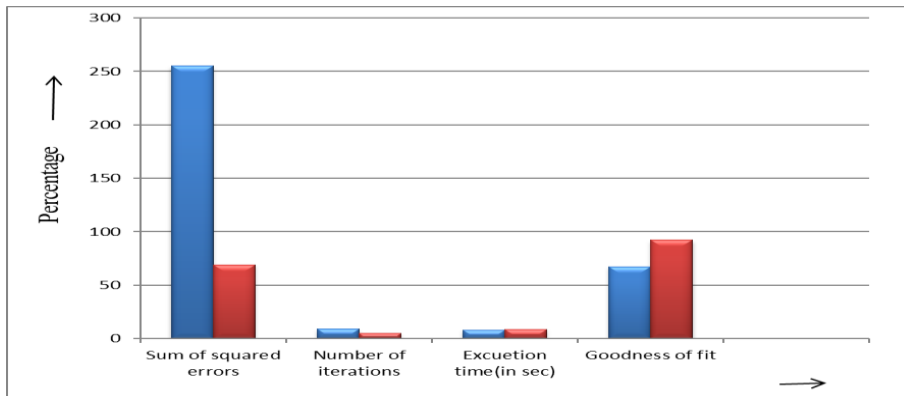


Figure 9 Comparison of Time Execution, the sum of errors, accuracy, and iteration in M-tree through graph representation

test negative	1 test positive	Model does the test
454	46	Negative - WELL DEFINED
23	245	Positive test- ILL DEFINED.

Table 1.3M-tree classifier for test determine

Division of cluster	Cluster 1	Cluster 2
Objects	477	291
Percentage	62%	38%

Table 1.4 Cluster Assignment using M-tree classifier

The accompanying tables show the examination of the negative and positive trials of the bosom malignancy illness patients, the unpredicted worth of the examples, and the precision of the M-tree classifier calculation on medical clinic-based genuine informational collection. Further, we will talk about of choice tree classifier approach of bosom malignant growth informational collection for the expectation of positive and negative record set of patients, the unpredicted worth of the occurrences, and exactness of the M-tree calculation on In these tables, 0 represents a negative test for predicting breast cancer.

**One represents a positive test for predicting breast cancer**

**Tables show-tree model detect for the unpredicted value of instances and accuracy**

This table shows the final result of our analysis. It shows some errors/In corrected instances, Percentage of errors and accuracy.

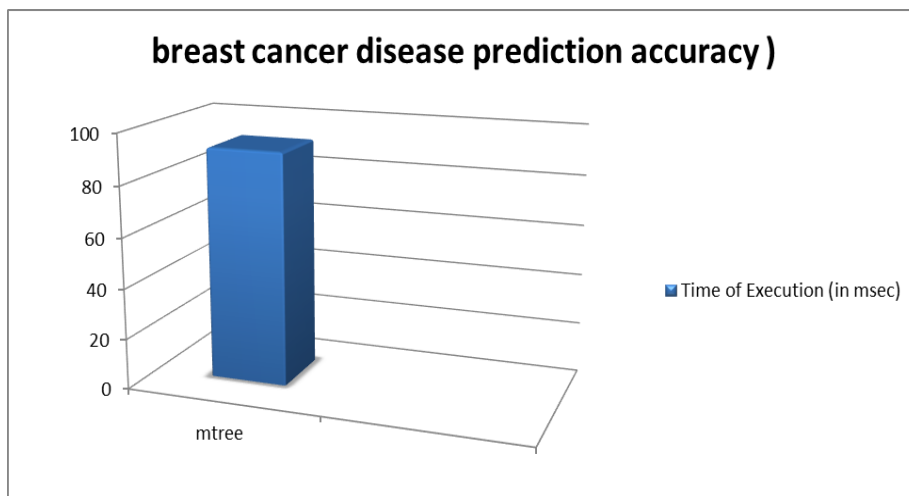


Fig 10 proposed algorithm generates accuracy graph on disease prediction concerning time execution.

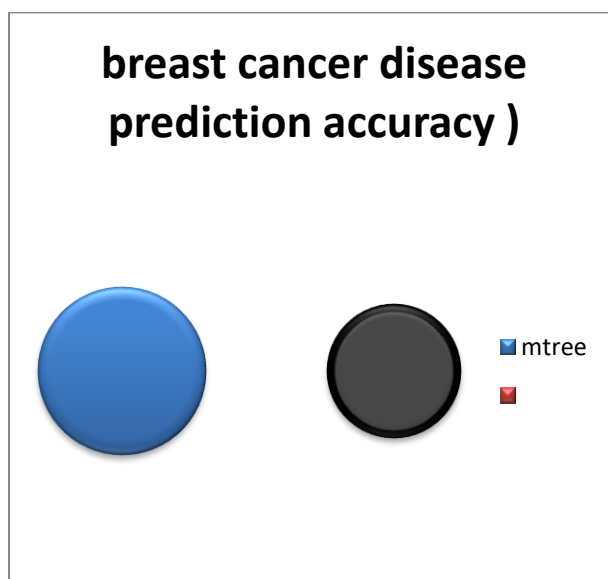


Fig 11 M-Tree graph representation of disease prediction.

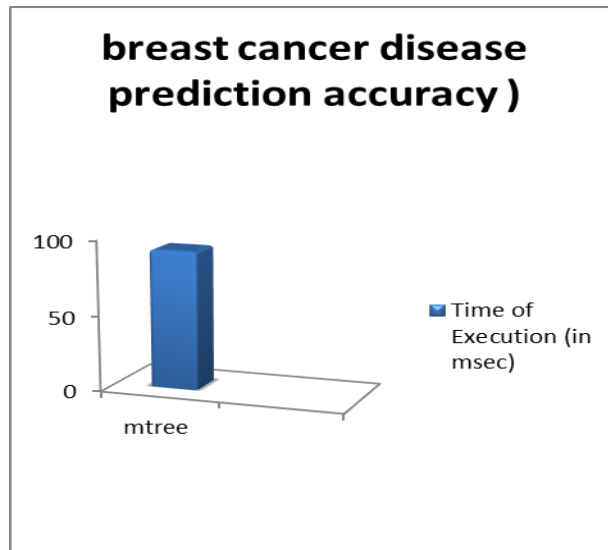


Fig 12 proposed algorithm generates time execution of accuracy determined X Experimental Outcomes

The following table shows the assignment of clusters using the M-tree. The dataset contains 768 attributes divided into two clusters shown in the table. The experimental outcome of the proposed M-tree based breast cancer prediction model is as follows:

1. The proposed algorithm determines the prediction of disease based on patient records data set as parameters values of record like medical record set.
2. M-Tree algorithm used training and testing methods to determine the accuracy of ML-based breast cancer disease detection techniques.

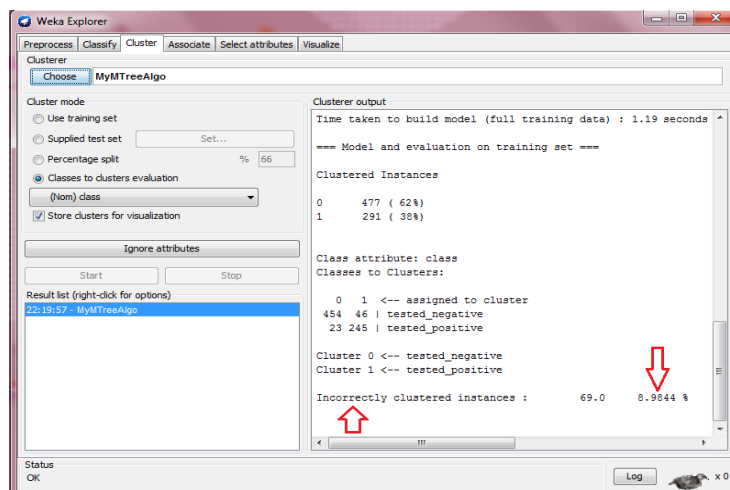


Figure 13 Snapshot of WEKA simulation tool by using M-tree.

The outcome of the M-tree classifier is the outcome of clustering algorithms like another algorithm. The result has been compared in terms of the Sum of Squared Errors, Number of Iterations, Execution Time, and Goodness of Fit (accuracy).

## Conclusion

we will configure the proposed tree classifier and initially execute it in the weka recreation device. We will get the positive outcome and exactness worth of this calculation for discovery of bosom malignant growth illness patients credits. After that, we will go for the A.I. examination dependent on the PYCHARM reenactment instrument and weka code. We will perform the same proposed M\_ tree calculation in weka and perform 92.125 not settled and produced diagram portrayal of given qualities.

This paper concludes that the accuracy of the M-tree algorithm for the prediction level of breast cancer disease is 92.125%, percentage errors 8.999%, and unpredicted value is 91.25% of cancer disease prediction using weka simulate tool with the help of patients records based data set as define various parameters values. The accuracy levels are approx. Is 92% of breast cancer disease prediction. This proposed algorithm performed the training and testing method for disease prediction based on parameters valued from the pre-define data set. The accuracy rate of this algorithm for breast cancer disease detection and prediction is higher than other ML algorithms.

## References

1. D. Lavanya et al. 2011, "*Analysis of Feature Selection with classification: Breast Cancer Datasets.*", Intl. J of Computer Science& Engineering (IJCSSE), vol. 2, No. 5, Oct-Nov 2011, ISSN: 0976-5166.
2. B. Nithya, V. Ilango, 2017, "*Comparative Analysis of Classification Methods in R Environment with two Different Datasets.*" Intl JScientific Research and Computer Science, Engineering and Information Technology (IJSRCSEIT), vol 2, Issue 6, ISSN: 2456-3307.
3. Deepika Verma et al., 2017. "*Analysis and Prediction of Breast Cancer and Diabetes disease datasets using Data Mining Classification Techniques.*" IEEE Xplore Proceeding of the Intl. Conf. on Intelligent Sustainable Systems (ICISS 2017), IEEE Xplore Compliant – part number: CFP17M19-ART, ISBN:978-1-5386-1959-9
4. Niyati Gupta et al. 2013, "*Accuracy, Sensitivity, and Specificity Measurement of Various Classification Techniques on Healthcare data.*", IOSR J. of Computer Engineering (IOSR-JCE), e-ISSN: 2278-0661, p-ISSN: 2278-8727, vol.11, issue 5, pp 70-73, May-Jun 2017.
5. Morteza Heidari et al. 2017. "*Prediction of Breast Cancer Risk using machine Learning Approach embedded with a Locality Preserving Projection Algorithm.*" Institute of Physics in Medicine and Biology(IPEM), DOI: <https://doi.org/10.1088/1361-6560/aaa1ca>.
6. T. John Peter et al. 2012. "*Study and Development of Novel Feature Selection Framework for Heart Disease Prediction.*" Intl J. Scientific and Research Publication, IJSRP. Vol.2 Issue 10, (Oct. 2012), ISSN: 2250-3153.

7. Mahua Nandy, 2013. "An Analytical Study of Supervised and unsupervised Classification Methods for Breast Cancer Diagnosis." 2<sup>nd</sup> Intl conf on Computing Communication and Sensor Network (CCSN-2013), Proceedings published by Intl. J Computer Application (IJCA)
8. Wenbin Yue, Zidong Wang, Hongwei Chen, and Annette Payne. May 2018. "Machine Learning with Applications in Breast cancer diagnosis and Prognosis.", [www.mdpi.com/journal/designs](http://www.mdpi.com/journal/designs) Design2018, 2, 13; doi:10.3390/designs2018.
9. Mohd. Milon Islam et al. 2017. *Prediction of Breast Cancer using Support Vector Machine and K-Nearest Neighbours.*, 2017 IEEE Region 10 Humanitarian Technology Conference (R10-HTC), Dec 21-23, 2017, Dhaka, Bangladesh.
10. AmitBhola, Arvind Kumar Tiwari, December 2015, "Machine Learning Based Approaches for Cancer Classification using Gene Expression Data." Machine Learning and Application: An Intl. J.(MLAIJ), Vol 2, No.3/4
11. Pedro D., Micheal P., 1997, "On the Optimality of the Simple Bayesian Classifier under Zero-One Loss.", Machine Learning, 29, 103-130(1997), Kluwer Academic Publishers, Netherlands.
12. Wenbin Yue, Zidong Wang, Hongwei Chen, and Annette Payne. May 2018. "Machine Learning with Applications in Breast cancer diagnosis and Prognosis.", [www.mdpi.com/journal/designs](http://www.mdpi.com/journal/designs) Design2018, 2, 13; doi:10.3390/designs2018.
13. Isabelle Guyon, Jason W., Stephen B., et al., 2002, "Gene Selection for Cancer Classification using Support Vector Machine, Machine Learning," vol.46, pp 389-422, 2002, Springer, Kluwer Academic Publishers, Netherlands
14. D. Coomans, D.L.Massart, 1982, "Alternate k-Nearest Neighbour Rules in Supervised Pattern Recognition, Part-1. k-NN classification by using Alternative Voting Rules.", Analytica Chimica Acta, 136 (1982)15-27, Elsevier Scientific Publishing Company, Amsterdam, Netherlands
15. Leo Breiman, 2001, "Random Forests, Machine Learning," vol. 45, issue 1, pp 5-32, Oct 2001, Springer, Kluwer Academic Publishers, Netherlands
16. Dursun Delen, Glenn Walker, Amit Kadam, 2005, "Predicting Breast Cancer Survivability: a comparison of three data mining methods.", ELSEVIER Artificial Intelligence in Medicine (2005), 34, 113-127. DOI: 10.1016/j.artmed.2004.07.002
17. A. Marcano-Cedeno et al. 2011, "WBCD breast cancer database classification applying artificial metaplasticity neural network.",
18. Banu Rahaman S. and ShashiM., "Sequential mining equips e-Health with knowledge for managing diabetes," 4<sup>th</sup> International Conference on New Trends in Information Science and Service Science (NISS), 2010, pp.65-71.
19. Frawley, W., Batheus, C., 1991. *Knowledge Discovery in Databases: An Overview.* In Piatesky-Shapiro, G., and Frawley, W. (Eds.), Knowledge Discovery in Databases, MIT Press, Cambridge, MA, pp1-
20. Han, J., Kamber, M., 2001. Data Mining: Concepts and Techniques, Morgan Kaufmann, San Fco., CA., USA.
21. Witten, I. H., Frank, E. 2000. Data mining: Practical machine learning tools and techniques with Java implementations. Morgan Kaufmann, San Francisco, CA. USA, 371 pp. Hand D.J., Mannila H., Smyth P. 2001. *Principles of data mining*, MIT Press, Boston, MA., USA.

22. Anunciacao Orlando, Gomes C. Bruno, Vigna Susana, Gaspar Jorge, Oliveira L. Arlindo and Rueff Jose, "A Data Mining approach for detecting high-risk Breast Cancer groups," *Advances in Soft Computing*, vol. 74, pp. 43-51, 2010.
23. Sarvestan Soltani A., Safavi A. A., Parandeh M. N. and Salehi M., "Predicting Breast Cancer Survivability using data mining techniques," *Software Technology and Engineering (ICSTE), 2nd International Conference*, 2010, vol.2, pp.227-231.
24. Abdelaal Ahmed Mohamed Medhat and Farouq Wael Muhamed, "Using data mining for assessing breast cancer diagnosis," in *Proc. International multiconference on computer science and information technology*, 2010, pp. 11-17.
25. Gandhi Rajiv K., Karnan Marcus, and Kannan S., "Classification rule construction using particle swarm optimization algorithm for breast cancer datasets," *Signal Acquisition and Processing. SAP, International Conference*, 2010, pp. 233 – 237.
26. Manaswini Pradhan and Dr. Ranjit Kumar Sahu, "Predict the onset of diabetes disease using Artificial Neural Network (ANN)," *International Journal of Computer Science & Emerging Technologies (E-ISSN: 2044-6004)*, pp.303 - 311, vol. 2, Iss. 2, 2011.
27. Padmavati J., "A Comparative study on Breast Cancer Prediction Using RBF and MLP," *International Journal of Scientific & Engineering Research*, vol. 2, Jan. 2011.
28. Kahraman Humar and Allahverdi Novruz, "Mining Classification Rules for Liver Disorders," *International Journal of Mathematics and Computers in Simulation*, vol. 3, 2009.
29. Suneetha N., Hari V. M. K., and Kumar V.S., "Modified Gini Index Classification: A Case Study of Heart Disease Dataset," *International Journal on Computer Science and Engineering*, issue 6, vol. 2, pp. 1959-1965, 2010.
30. Elsayed A. M., "Diagnosis of Erythemato-Squamous Diseases using Ensemble of Data Mining Methods," *ICGST-BIME Journal*, issue 1, vol. 10, 2010.
31. David A. Omondiagbe, Shanmugam Veeramani, and Amandeep S. Sidhu Machine Learning Classification Techniques for Breast Cancer Diagnosis (2019).
32. "Latest Global Cancer Data: Cancer burden rises to 18.1 million new cases and 9.6 million cancer deaths in 2018", International Agency for Research on Cancer, World Health Organization, 12 September 2018.
33. *Procedia Computer Science* 83 ( 2016 ) 1064 – 1069 1877-0509 © 2016 The Authors.
34. *Hindawi Journal of Healthcare Engineering* Volume 2019, Article ID 4253641, <https://doi.org/10.1155/2019/4253641>.
35. E. Aličković and A. Subasi, "Breast cancer diagnosis using G.A. feature selection and Rotation Forest," *Neural Computing and Applications*, vol. 28, no. 4, pp. 753–763, 2017.
36. M. Banaie, H. Soltanian-Zadeh, H.-R. Saligheh-Rad, and M. City, "Spatiotemporal features of DCE-MRI for breast cancer diagnosis," *Computer Methods and Programs in Biomedicine*, vol. 155, pp. 153–164, 2018.
37. S. Bouaziz, H. Dhahri, A. M. Alimi, and A. Abraham, "Evolving flexible beta basis function neural tree using extended genetic programming & hybrid artificial bee colony," *Applied Soft Computing*, vol. 47, pp. 653–668, 2016.

38. K. P. Bennett, "Decision tree construction via linear programming," in *Proceedings of the 4th Midwest Artificial Intelligence and Cognitive Science Society*, pp. 97–101, Utica, IL, USA, 1992.
39. N. Hoque, D. K. Bhattacharyya, and J. K. Kalita, "MIFS-ND: a mutual information-based feature selection method," *Expert Systems with Applications*, vol. 41, no. 14, pp. 6371–6385, 2014.
40. F. Pedrosa, G. Varoquaux, A. Gramfort et al., "Scikit-learn: machine learning in Python," *Journal of Machine Learning Research*, vol. 12, pp. 2825–2830, 2011.
41. J. M. Keller, M. R. Gray, and J. A. Givens, "A fuzzy K-nearest neighbor algorithm," *IEEE Transactions on Systems, Man, and Cybernetics*, vol. SMC-15, no. 4, pp. 580–585, 1985.
42. Rodrigues, B.L.: Analysis of the Wisconsin Breast Cancer dataset and machine learning for breast cancer detection. In: Proceedings of XI Workshop de Visão Computational, pp. 15–19 (2015).
43. Chaurasia, V., Pal, S.: A novel approach for breast cancer detection using data mining techniques. *Int. J. Innovative Res. Comput. Commun. Eng.* 2 (2017). (An ISO 3297: 2007 Certified Organization)
44. Suryasa, I. W., Rodríguez-Gámez, M., & Koldoris, T. (2021). The COVID-19 pandemic. *International Journal of Health Sciences*, 5(2), vi-ix. <https://doi.org/10.53730/ijhs.v5n2.2937>
45. Suryasa, I. W., Rodríguez-Gámez, M., & Koldoris, T. (2022). Post-pandemic health and its sustainability: Educational situation. *International Journal of Health Sciences*, 6(1), i-v. <https://doi.org/10.53730/ijhs.v6n1.5949>