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A Comprehensive Survey on Breast Cancer: Advances, Challenges, and Future Directions

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Abstract: **Breast cancer is a common form of cancer that impacts women all over the globe. It is a complex and heterogeneous disease with varying clinical presentations, molecular subtypes, and treatment responses. Significant progress has been made in the field of breast cancer research, leading to improved diagnosis, treatment strategies, and patient outcomes. This paper aims to give a thorough summary of the present knowledge of breast cancer. It will focus on significant developments, obstacles, and potential directions for the future.**

Keywords: Breast cancer, Epidemiology, Globally, Lumpectomy.

I. Introduction

Definition and epidemiology of breast cancer

Definition:

Breast cancer is a type of cancer that starts in the breast tissue. It often begins in the milk ducts or lobules, which are responsible for producing milk. The uncontrolled and abnormal growth of cells in the breast can result in the formation of tumors that may invade nearby tissues and even spread to other parts of the body through the lymphatic system or bloodstream.

Epidemiology:

Breast cancer is a prevalent form of cancer among women globally, but it can also affect men, albeit at a much lower rate. The epidemiology of breast cancer involves the study of its occurrence, distribution, and determinants in different populations.

some key epidemiological facts:

Incidence: Breast cancer has a significant global impact. As per the World Health Organization (WHO), around 2.3 million fresh instances of breast cancer were detected in the year 2020. Incidence rates vary across regions, with higher rates observed in North America, Europe, and Australia compared to Africa and Asia.

Mortality: Breast cancer remains a prominent cause of cancer-related fatalities in women globally. The mortality rates differ depending on various factors, including the stage of diagnosis, accessibility to quality healthcare, and treatment options. Fortunately, early detection and advancements in treatment have led to better survival rates in several nations.

It is important to undergo regular breast cancer screening to detect any signs of the disease at an early stage. This includes mammography, clinical breast examination, and self-examination. Early detection significantly improves the chances of successful treatment and better outcomes.

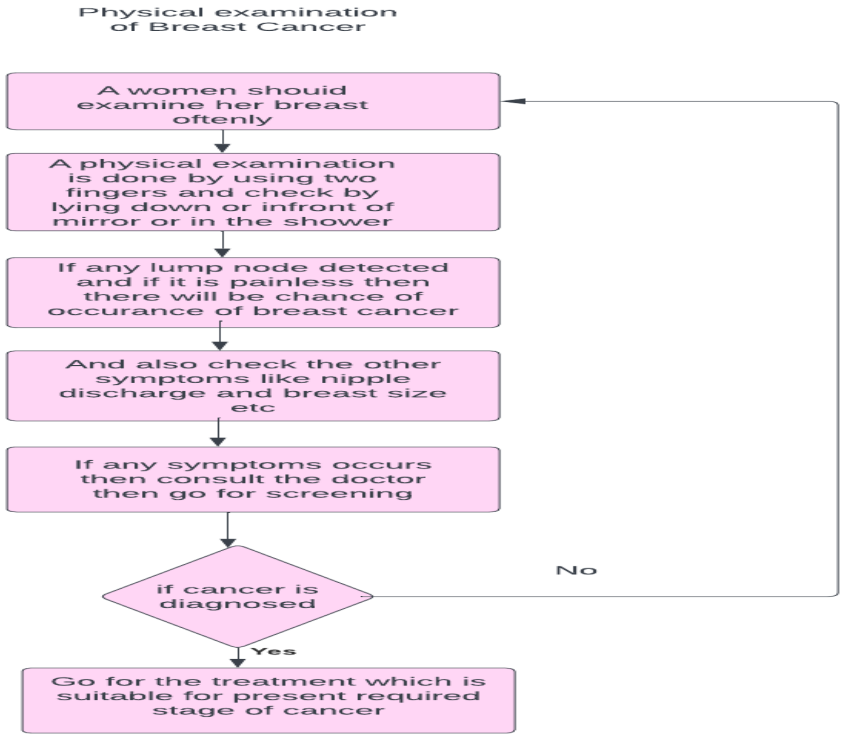

Fig 1 Physical Examination of Breast Cancer

II. Factors that Increase Risk and Genetic Predisposition of Breast Cancer

Gender: Although breast cancer can affect both men and women, being female is the primary risk factor for this disease. It is much more prevalent among women.

Age: As women age, their risk of developing breast cancer increases. In fact, a majority of breast cancer cases are diagnosed in women over the age of 50, and the risk continues to increase with each passing year.

Family History and Genetic Mutations: Having a family history of breast cancer is a major risk factor for developing the disease. If someone's mother, sister, or daughter has had breast cancer, their risk of developing the disease is higher. In some cases, breast cancer can be linked to specific inherited gene mutations, the most well-known being BRCA1 and BRCA2. Individuals who carry these genetic mutations are at a greater risk of developing breast and ovarian cancers over the course of their lifetime.

Reproductive Factors: There are specific reproductive factors that can impact the risk of developing breast cancer. These factors include starting menstruation at a young age (before 12 years old), experiencing menopause at a later age (after 55 years old), not giving birth, having a first child after the age of 30, and not breastfeeding.

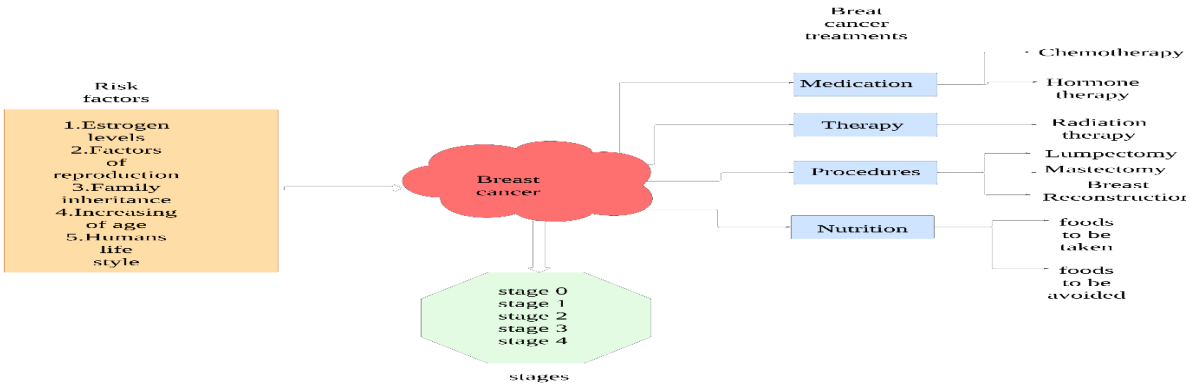

Fig 2 Risk Factors of Breast Cancer

III. Importance of early detection and screening

Detecting and screening for breast cancer at an early stage is vital for effective management. Here are the key reasons why early detection and regular screening are important:

Detecting breast cancer at an early stage can greatly improve treatment outcomes and increase the likelihood of successful treatment. When breast cancer is diagnosed early, it is often smaller in size and localized to the breast, making it more treatable and potentially curable.

Increased Treatment Options: Early detection allows for a wider range of treatment options. In the early stages, breast-conserving surgery (lumpectomy) may be possible, which preserves the breast while removing the tumor. This is often followed by radiation therapy, Reducing the risk of local recurrence is an important consideration in the treatment of breast cancer, particularly in its early stages where less aggressive treatment may be necessary when compared to advanced-stage cancer.

Reduced Mortality: Early detection through screening has been associated with a decrease in breast cancer-related mortality. Identifying cancer at an early stage through screening can greatly improve the chances of successful treatment and reduce the risk of it spreading to other parts of the body, ultimately leading to higher survival rates.

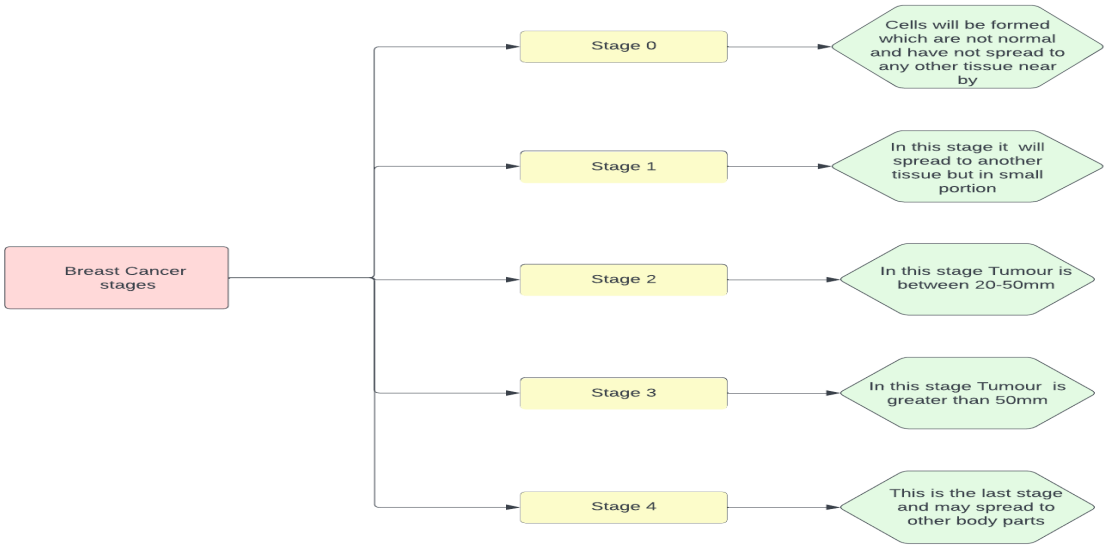

Fig 3 Stages of Breast Cancer

Stages	Description of growth level	5year survival rate(women)	5year survival rate(men)
Stage 0	Tumor that have not grown beyond.	100%	100%
Stage 1	In this stage, the tumor size is less than 2cm (<2cm).	100%	100%
Stage 2	In this stage, the tumor size is greater than 2cm(>2cm) and less than 5cm(<5cm).	93%	91%
Stage 3	In this stage, the tumor is greater than 5cm(>5cm) and it will spread to other nodes.	72%	72%
Stage 4	In this stage, it will spread to other parts of the body like bone, liver, and lungs.	22%	20%

Table 1 Comparison of Growth of cancer in women and men in different stages

IV. The Pathology of Breast Cancer

Breast cancer's pathophysiology involves intricate cellular and molecular alterations that result in the illness's growth and advancement. Here's an outline of the critical elements of breast cancer's pathophysiology.

Genetic Alterations: Breast cancer arises due to genetic abnormalities that result in uncontrolled cell growth. Changes or mutations in certain genes, like BRCA1, BRCA2, TP53, and others, can heighten the chances of developing breast cancer. These genetic alterations can be inherited or acquired during a person's lifetime.

Hormones are a major contributor to the development of breast cancer. Breast cancer cells contain receptors for estrogen and progesterone, and when these hormones bind to the receptors, they can trigger cell growth. Hormone receptor-positive breast cancers rely on the presence of estrogen and/or progesterone for their growth and are often treated with hormone therapy.

Tumor Heterogeneity: Breast cancer is not a uniform disease because it is made up of various types of cancer cells within the tumor. The tumor may display differences in gene expression patterns, cellular morphology, and reaction to treatment in different regions. This heterogeneity can impact treatment effectiveness and contribute to the development of resistance.

Invasive breast cancer new cases	287,500
Non-Invasive (situ) cases	51,400
Total percentage of cases	30%
Death cases of women	43,500
Breast cancer cases in men	2,710
Death cases of men	530

Table 2 Breast cancer cases 2022(us)

Breast Cancer Diagnosis

Breast cancer diagnosis involves a comprehensive approach that combines clinical evaluation, imaging techniques, and biopsy for histopathological examination. The following are key components of breast cancer diagnosis:

Clinical Evaluation:

Medical History: The healthcare provider will assess the patient's medical history, including any symptoms or risk factors associated with breast cancer.

Physical Examination: A thorough physical examination of the breasts and surrounding lymph nodes is conducted to check for any abnormalities, such as lumps, changes in skin texture, nipple discharge, or enlarged lymph nodes.

Imaging Techniques:

Mammography: Mammograms are X-ray images of the breasts and are the primary screening tool for breast cancer. They can detect early-stage tumors or abnormal calcifications that may require further evaluation.

Ultrasound: Ultrasound of the breast employs sound waves to create visual representations of the breast tissue. This helps differentiate between solid masses and fluid-filled cysts and can be used to guide needle biopsies.

V. Treatment Modalities

The approach to treating breast cancer is dependent on several factors such as the stage of the disease, tumor characteristics, the patient's general well-being, and personal preferences.

The following are the main treatment modalities used for breast cancer:

Surgery: If you have a breast tumor, you may consider undergoing Breast-Conserving Surgery (also known as Lumpectomy). This procedure involves removing the tumor along with a small margin of normal tissue surrounding it, all while preserving the breast. After the surgery, radiation therapy is typically recommended to further treat the affected area.

Mastectomy: The procedure known as mastectomy entails the complete removal of breast tissue. In certain cases, further evaluations like sentinel lymph node biopsy or axillary lymph node dissection may be conducted to determine lymph node involvement, depending on the severity of the disease.

Radiation Treatment:

External Beam Radiation is a form of radiation therapy that utilizes high-energy beams to eliminate cancer cells or inhibit their growth in the affected breast area. It is typically used following breast-conserving surgery or mastectomy to minimize the possibility of local recurrence.

Systemic Therapy:

Chemotherapy: Chemotherapy is a treatment that involves using medication to halt the growth of cancer cells in the body. It can be administered before surgery (neoadjuvant) to reduce the size of tumors, after surgery (adjuvant) to eradicate any lingering cancer cells, or for advanced or metastatic breast cancer.

Hormone Therapy: Hormone therapy is a treatment option for hormone receptor-positive breast cancers. This method utilizes medications that either lower estrogen production or block its effects, preventing the growth of hormone-dependent cancer cells.

VI. Personalized Medicine and Precision Oncology

Personalized medicine and precision oncology are approaches to cancer treatment that aim to tailor therapies to individual patients based on the specific characteristics of their tumors and their own genetic makeup. These approaches recognize that each patient's cancer is unique, and treatment decisions should be informed by the specific molecular and genetic features of the tumor.

Here are the key components of personalized medicine and precision oncology:

Molecular Profiling: Personalized medicine begins with comprehensive molecular profiling of the tumor. This involves analyzing the genetic and molecular alterations in the tumor cells to identify specific mutations, gene expression patterns, and biomarkers that may drive the growth and progression of cancer.

Biomarker Testing: Biomarker testing is performed to identify specific molecular markers in the tumor that can guide treatment decisions. Biomarkers encompass hormone receptors like estrogen and progesterone receptors, expression of HER2/neu protein, and specific genetic mutations such as BRCA1/2. Biomarker testing helps determine which targeted therapies or standard treatments are most likely to be effective for a particular patient.

Targeted Therapies: Targeted therapies refer to medications that specifically aim to target the molecular alterations or

pathways that contribute to the growth and survival of cancer cells. They are designed to interfere with specific molecules or signaling pathways to inhibit tumor growth. There are several types of targeted therapies available, such as tyrosine kinase inhibitors, monoclonal antibodies, and PARP inhibitors.

VII. Challenges and Limitations

Although personalized medicine and precision oncology present hopeful strategies for cancer treatment, there exist multiple challenges and limitations that require attention.

Some of these include:

Biomarker Identification: Identifying relevant biomarkers for each individual patient and tumor can be complex. There is a need for comprehensive molecular profiling techniques that can accurately and efficiently identify the molecular alterations driving cancer. Additionally, some tumors may not have well-defined biomarkers or may have multiple genetic alterations, making treatment selection more challenging.

Heterogeneity and Tumor Evolution: Tumors are often heterogeneous, meaning that they consist of different subpopulations of cancer cells with distinct genetic profiles. This heterogeneity can lead to variations in treatment response and the emergence of resistant cell populations. Tumor evolution over time can also result in the development of new genetic alterations that may impact treatment effectiveness.

VIII. Future Directions and Emerging Technologies

Emerging technologies hold great potential to further advance personalized medicine and precision oncology in the future.

Here are some notable areas of development:

Genomic Sequencing: Next-generation sequencing technologies are becoming more accessible and cost-effective, enabling comprehensive genomic profiling of tumors. Through methods such as whole-genome sequencing, whole-exome sequencing, and targeted gene panel sequencing, individuals can obtain an abundance of genetic information that can assist in determining treatment options and identifying potential therapeutic targets.

Liquid Biopsies: Liquid biopsy techniques, such as circulating tumor DNA (ctDNA) analysis, are being refined and integrated into clinical practice. These non-invasive tests allow for the monitoring of tumor dynamics, detection of minimal residual disease, assessment of treatment response, and identification of emerging resistance mechanisms. Ongoing research aims to improve the sensitivity and specificity of liquid biopsies for enhanced clinical utility.

Single-Cell Analysis: Single-cell sequencing technologies enable the profiling of individual cells within a tumor, providing insights into intertumoral heterogeneity and clonal evolution. By capturing the genetic and transcriptomic profiles of individual cells, single-cell analysis can help identify rare subpopulations of cells, understand cellular interactions, and guide treatment strategies tailored to specific cell populations.

IX. Conclusion

In conclusion, personalized medicine and precision oncology have emerged as promising approaches in the field of cancer treatment. By considering the unique characteristics of each patient's tumor and genetic makeup, these approaches aim to optimize treatment outcomes, minimize side effects, and improve overall patient care.

Breast cancer diagnosis relies on a combination of imaging techniques, such as mammography, ultrasound, and MRI, along with tissue biopsies for histopathological evaluation. Accurate and timely diagnosis is crucial for determining the stage and extent of the disease, which guides treatment planning.

X. References

[1]. Bray, F., Ferlay, J., Soerjomataram, I., Siegel, R. L., Torre, L. A., & Jemal, A. (2018). Global cancer statistics 2018: GLOBOCAN estimates of incidence and mortality worldwide for 36 cancers in 185 countries. CA: A Cancer Journal for Clinicians, 68(6), 394-424.

[2]. Howlader, N., Noone, A. M., Krapcho, M., Miller, D., Brest, A., Yu, M., ... & Cronin, K. A. (Eds.). (2021). SEER Cancer Statistics Review, 1975-2018. National Cancer Institute. Retrieved from: https://seer.cancer.gov/csr/1975_2018/

[3]. American Cancer Society. (2021). Breast Cancer Facts & Figures 2021-2022. Atlanta: American Cancer Society, Inc. Retrieved from: https://www.cancer.org/content/dam/cancer-org/research/cancer-facts-and-statistics/breast-cancer-facts-and-figures/breast-cancer-facts-and-figures-2021-2022.pdf

[4]. National Comprehensive Cancer Network. (2021). NCCN Clinical Practice Guidelines in Oncology: Breast Cancer. Version 8.2021. Retrieved from: https://www.nccn.org/professionals/physician_gls/pdf/breast.pdf

[5]. Cardoso, F., Paluch-Shimon, S., Senkus, E., Curigliano, G., Aapro, M. S., André, F., ... & Obi, N. (2019). 5th ESO-ESMO International Consensus Guidelines for Advanced Breast Cancer (ABC 5). Annals of Oncology, 31(12), 1623-1649.

[6]. Zhang X, Shengli SU, Hongchao WA. Intelligent diagnosis model and method of palpation imaging breast cancer based on data mining. *Big Data Research* . 2019;5(1):2019005. doi: 10.11959/j.issn.2096-0271.2019005. [CrossRef] [Google Scholar]

[7]. Chen SI, Tseng HT, Hsieh CC. Evaluating the impact of soy compounds on breast cancer using the data mining approach. *Food & function* . 2020;11(5):4561–70. doi: 10.1039/C9FO00976K. [PubMed] [CrossRef] [Google Scholar]

[8]. Aavula R, Bhramaramba R, Ramula US. A Comprehensive Study on Data Mining Techniques

used in Bioinformatics for Breast Cancer Prognosis. *Journal of Innovation in Computer Science and Engineering* . 2019;9(1):34–9. [Google Scholar]

[9]. Kaushik D, Kaur K. Application of Data Mining for high accuracy prediction of breast tissue biopsy results. 2016 Third International Conference on Digital Information Processing, Data Mining, and Wireless Communications (DIPDMWC); Moscow, Russia: IEEE; 2016. p. 40-5. doi: 10.1109/DIPDMWC.2016.7529361. [CrossRef] [Google Scholar]

[10]. Dalal, S., Poongodi, M., Lilhore, U. K., Dahan, F., Vaiyapuri, T., Keshta, I., ... & Simaiya, S. Optimized LightGBM model for security and privacy issues in cyber-physical systems. Transactions on Emerging Telecommunications Technologies, e4771.

[11]. Dalal, S., Manoharan, P., Lilhore, U. K., Seth, B., Simaiya, S., Hamdi, M., & Raahemifar, K. (2023). Extremely boosted neural network for more accurate multi-stage Cyber attack prediction in cloud computing environment. Journal of Cloud Computing, 12(1), 1-22.

[12]. Malik, A., Onyema, E. M., Dalal, S., Kumar, U., Anand, D., Sharma, A., & Simaiya, S. (2023). Forecasting students' adaptability in online entrepreneurship education using modified ensemble machine learning model. Array, 100303.

[13]. Shetty, S., & Dalal, S. (2022, December). Bi-Directional Long Short-Term Memory Neural Networks for Music Composition. In 2022 Fourth International Conference on Emerging Research in Electronics, Computer Science and Technology (ICERECT) (pp. 1-6). IEEE.

[14]. Dalal, S. (2023, April). The Smart Analysis of Poisson Distribution Pattern Based Industrial Automation in Industry 4.0. In 2023 International Conference on Distributed Computing and Electrical Circuits and Electronics (ICDCECE) (pp. 1-6). IEEE.

[15]. Dalal, S., Seth, B., Radulescu, M., Cilan, T. F., & Serbanescu, L. (2023). Optimized Deep Learning with Learning without Forgetting (LwF) for Weather Classification for Sustainable Transportation and Traffic Safety. Sustainability, 15(7), 6070.

[16]. Onyema, E. M., Lilhore, U. K., Saurabh, P., Dalal, S., Nwaeze, A. S., Chijindu, A. T., ... & Simaiya, S. (2023). Evaluation of IoT-Enabled hybrid model for genome sequence analysis of patients in healthcare 4.0. Measurement: Sensors, 26, 100679.

[17]. Dalal, S., Manoharan, P., Lilhore, U. K., Seth, B., Simaiya, S., Hamdi, M., & Raahemifar, K. (2023). Extremely boosted neural network for more accurate multi-stage Cyber attack prediction in cloud computing environment. Journal of Cloud Computing, 12(1), 1-22.

[18]. Dalal, S., Goel, P., Onyema, E. M., Alharbi, A., Mahmoud, A., Algarni, M. A., & Awal, H. (2023). Application of Machine Learning for Cardiovascular Disease Risk Prediction. Computational Intelligence and Neuroscience, 2023.

[19]. Dalal, S., Seth, B., Radulescu, M., Secara, C., & Tolea, C. (2022). Predicting Fraud in Financial Payment Services through Optimized Hyper-Parameter-Tuned XGBoost Model. Mathematics, 10(24), 4679.

[20]. Dalal, S., Onyema, E. M., & Malik, A. (2022). Hybrid XGBoost model with hyperparameter tuning for prediction of liver disease with better accuracy. World Journal of Gastroenterology, 28(46), 6551-6563.

[21]. Edeh, M. O., Dalal, S., Obagbuwa, I. C., Prasad, B. V. V., Ninoria, S. Z., Wajid, M. A., & Adesina, A. O. (2022). Bootstrapping random forest and CHAID for prediction of white spot disease among shrimp farmers. Scientific Reports, 12(1), 1-12.

[22]. Zaki, J., Nayyar, A., Dalal, S., & Ali, Z. H. (2022). House price prediction using hedonic pricing model and machine learning techniques. Concurrency and Computation: Practice and Experience, 34(27), e7342.

[23]. Dalal, S., Onyema, E., Romero, C., Ndufeiya-Kumasi, L., Maryann, D., Nnedimkpa, A. & Bhatia, T. (2022). Machine learning-based forecasting of potability of drinking water through adaptive boosting model. Open Chemistry, 20(1), 816-828. https://doi.org/10.1515/chem-2022-0187

[24]. Onyema, E. M., Dalal, S., Romero, C. A. T., Seth, B., Young, P., & Wajid, M. A. (2022). Design of Intrusion Detection System based on Cyborg intelligence for security of Cloud Network Traffic of Smart Cities. Journal of Cloud Computing, 11(1), 1-20.

[25]. Dalal, S., Onyema, E. M., Kumar, P., Maryann, D. C., Roselyn, A. O., & Obichili, M. I. (2022). A Hybrid machine learning model for timely prediction of breast cancer. International Journal of Modeling, Simulation, and Scientific Computing, 2023, 1-21.

[26]. Dalal, S., Seth, B., Jaglan, V., Malik, M., Dahiya, N., Rani, U., ... & Hu, Y. C. (2022). An adaptive traffic routing approach toward load balancing and congestion control in Cloud–MANET ad hoc networks. Soft Computing, 26(11), 5377-5388.

[27]. Edeh, M. O., Dalal, S., Dhaou, I. B., Agubosim, C. C., Umoke, C. C., Richard-Nnabu, N. E., & Dahiya, N. (2022). Artificial Intelligence-Based Ensemble Learning Model for Prediction of Hepatitis C Disease. Frontiers in Public Health, 847.

[28]. Seth, B., Dalal, S., Jaglan, V., Le, D. N., Mohan, S., & Srivastava, G. (2022). Integrating encryption techniques for secure data storage in the cloud.

Transactions on Emerging Telecommunications Technologies, 33(4), e4108.

[29]. Malik, M., Nandal, R., Dalal, S., Maan, U., & Le, D. N. An efficient driver behavioral pattern analysis based on fuzzy logical feature selection and classification in big data analysis. Journal of Intelligent & Fuzzy Systems, 43(3), 3283-3292.

[30]. Malik, M., Nandal, R., Dalal, S., Jalglan, V., & Le, D. N. (2022). Deriving driver behavioral pattern analysis and performance using neural network approaches. Intelligent Automation & Soft Computing, 32(1), 87-99.

[31]. Shetty, S., & Dalal, S. (2022, December). Bi-Directional Long Short-Term Memory Neural Networks for Music Composition. In 2022 Fourth International Conference on Emerging Research in Electronics, Computer Science and Technology (ICERECT) (pp. 1-6). IEEE.

[32]. Onyema, E. M., Shukla, P. K., Dalal, S., Mathur, M. N., Zakariah, M., & Tiwari, B. (2021). Enhancement of patient facial recognition through deep learning algorithm: ConvNet. Journal of Healthcare Engineering, 2021.

[33]. Dalal, S., & Khalaf, O. I. (2021). Prediction of occupation stress by implementing convolutional neural network techniques. Journal of Cases on Information Technology (JCIT), 23(3), 27-42.

[34]. Dalal, S., Jaglan, V., & Le, D.-N. (Eds.). (2021). Green Internet of Things for Smart Cities: Concepts, Implications, and Challenges (1st ed.). CRC Press. https://doi.org/10.1201/9781003032397.

[35]. Dahiya, N., Dalal, S., & Jaglan, V. (2021). 8 Mobility in Green Management IoT. Green Internet of Things for Smart Cities: Concepts, Implications, and Challenges, 125.

[36]. Dahiya, N., Dalal, S., & Jaglan, V. (2021). 7 Efficient Green Solution. Green Internet of Things for Smart Cities: Concepts, Implications, and Challenges, 113.

[37]. Seth, B., Dalal, S., & Dahiya, N. (2021). 4 Practical Implications. Green Internet of Things for Smart Cities: Concepts, Implications, and Challenges, 61.

[38]. Malik, M., Nandal, R., Dalal, S., Jalglan, V., & Le, D. N. (2021). Driving pattern profiling and classification using deep learning. Intelligent Automation & Soft Computing, 28(3), 887-906.

[39]. Jindal, U., Dalal, S., Rajesh, G., Sama, N. U., Jhanjhi, N. Z., & Humayun, M. (2021). An integrated approach on verification of signatures using multiple classifiers (SVM and Decision Tree): A multi-classification approach.

[40]. Seth, B., Dalal, S., Le, D. N., Jaglan, V., Dahiya, N., Agrawal, A., ... & Verma, K. D. (2021). Secure Cloud Data Storage System Using Hybrid Paillier–Blowfish Algorithm. Computers, Materials & Continua, 67(1), 779-798.

[41]. Vijarania, M., Dahiya, N., Dalal, S., & Jaglan, V. (2021). WSN Based Efficient Multi-Metric Routing for IoT Networks. In Green Internet of Things for Smart Cities (pp. 249-262). CRC Press.

[42]. Goel, M., Hayat, A., Husain, A., & Dalal, S. (2021). Green-IoT (G-IoT) Architectures and Their Applications in the Smart City. In Green Internet of Things for Smart Cities (pp. 47-59). CRC Press.

[43]. Chawla, N., & Dalal, S. (2021). Edge AI with Wearable IoT: A Review on Leveraging Edge Intelligence in Wearables for Smart Healthcare. Green Internet of Things for Smart Cities, 205-231.

[44]. Dahiya, N., Dalal, S., & Jaglan, V. (2021). Efficient Green Solution for a Balanced Energy Consumption and Delay in the IoT-Fog-Cloud Computing. In Green Internet of Things for Smart Cities (pp. 113-123). CRC Press.

[45]. Dahiya, N., Dalal, S., & Jaglan, V. (2021). Mobility Management in Green IoT. In Green Internet of Things for Smart Cities (pp. 125-134). CRC Press.

[46]. Seth, B., Dalal, S., & Dahiya, N. (2021). Practical Implications of Green Internet of Things (G-IoT) for Smart Cities. In Green Internet of Things for Smart Cities (pp. 61-81). CRC Press.

[47]. Dalal, S., Agrawal, A., Dahiya, N., & Verma, J. (2020, July). Software Process Improvement Assessment for Cloud Application Based on Fuzzy Analytical Hierarchy Process Method. In International Conference on Computational Science and Its Applications (pp. 989-1001). Springer, Cham.

[48]. Seth, B., Dalal, S., Jaglan, V., Le, D. N., Mohan, S., & Srivastava, G. (2020). Integrating encryption techniques for secure data storage in the cloud. Transactions on Emerging Telecommunications Technologies.

[49]. Hooda, M., & Shravankumar Bachu, P. (2020). Artificial Intelligence Technique for Detecting Bone Irregularity Using Fastai. In International Conference on Industrial Engineering and Operations Management Dubai, UAE (pp. 2392-2399).

[50]. Arora, S., & Dalal, S. (2019). An optimized cloud architecture for integrity verification. Journal of Computational and Theoretical Nanoscience, 16(12), 5067-5072.

[51]. Arora, S., & Dalal, S. (2019). Trust Evaluation Factors in Cloud Computing with Open Stack. Journal of Computational and Theoretical Nanoscience, 16(12), 5073-5077.

[52]. Shakti Arora, S. (2019). DDoS Attacks Simulation in Cloud Computing Environment. International Journal of Innovative Technology and Exploring Engineering, 9(1), 414-417.

[53]. Shakti Arora, S. (2019). Integrity Verification Mechanisms Adopted in Cloud Environment. International Journal of Engineering and Advanced Technology (IJEAT), 8, 1713-1717.

[54]. Sudha, B., Dalal, S., & Srinivasan, K. (2019). Early Detection of Glaucoma Disease in Retinal Fundus Images Using Spatial FCM with Level Set Segmentation. International Journal of Engineering and Advanced Technology (IJEAT), 8(5C), 1342-1349.

[55]. Sikri, A., Dalal, S., Singh, N. P., & Le, D. N. (2019). Mapping of e-Wallets With Features. Cyber Security in Parallel and Distributed Computing: Concepts, Techniques, Applications and Case Studies, 245-261.

[56]. Seth, B., Dalal, S., & Kumar, R. (2019). Hybrid homomorphic encryption scheme for secure cloud data storage. In Recent Advances in Computational Intelligence (pp. 71-92). Springer, Cham.

[57]. Seth, B., Dalal, S., & Kumar, R. (2019). Securing bioinformatics cloud for big data: Budding buzzword or a glance of the future. In Recent advances in computational intelligence (pp. 121-147). Springer, Cham.

[58]. Jindal, U., & Dalal, S. (2019). A hybrid approach to authentication of signature using DTSVM. In Emerging Trends in Expert Applications and Security (pp. 327-335). Springer, Singapore.

[59]. Le, D. N., Seth, B., & Dalal, S. (2018). A hybrid approach of secret sharing with fragmentation and encryption in cloud environment for securing outsourced medical database: a revolutionary approach. Journal of Cyber Security and Mobility, 7(4), 379-408.

[60]. Sikri, A., Dalal, S., Singh, N. P., & Dahiya, N. (2018). Data Mining and its Various Concepts. Kalpa Publications in Engineering, 2, 95-102.

[61]. Sameer Nagpal, S. (2018). Analysis of LrMu Power Algorithm in the Cloud Computing Environment using CloudSim Toolkit. International Journal of Research in Electronics and Computer Engineering (IJRECE), 6(3), 1175-1177.

[62]. Nagpal, S., Dahiya, N., & Dalal, S. (2018). Comparative Analysis of the Power Consumption Techniques in the Cloud Computing Environment. Journal Homepage: http://www. ijmra.us, 8(8), 1.

[63]. Kumar, N., Dalal, S., & Dahiya, N. (2018). Approach of Lion Optimization Algorithm for Efficient Load Balancing in Cloud Computing. Journal Homepage: http://www. ijmra.us, 8(8), 1.

[64]. Sameer Nagpal, S. (2018). Comparison of Task Scheduling in Cloud Computing Using various Optimization Algorithms. Journal of Computational Information Systems, 14(4), 43-57.

[65]. Arora, S., & Dalal, S. (2018). Hybrid algorithm designed for handling remote integrity check mechanism over dynamic cloud environment. International Journal of Engineering & Technology, 7(2.4), 161-164.

[66]. Kukreja, S., & Dalal, S. (2018). Modified drosophila optimization algorithm for managing re-sources in cloud environment. International Journal of Engineering & Technology, 7(2.4), 165-169.

[67]. Jindal, U., Dalal, S., & Dahiya, N. (2018). A combine approach of preprocessing in integrated signature verification (ISV). International Journal of Engineering & Technology, 7(1.2), 155-159.

[68]. Nagpal, S., Dahiya, N., & Dalal, S. (2018). Comparison of Task Scheduling in Cloud Computing Using various Optimization Algorithms. Journal of Computational Information Systems ISSN, 1553-9105.

[69]. Jindal, U., Dalal, S., & Dahiya, N. (2018). A combine approach of preprocessing in integrated signature verification (ISV). International Journal of Engineering & Technology, 7(1.2), 155-159

[70]. Shakti Arora, S. (2018). Resolving problem of Trust context in Cloud Computing. International Journal of Engineering Research in Computer Science and Engineering (IJERCSE), 5(1), 138-142.

[71]. Dalal, S., Dahiya, N., & Jaglan, V. (2018). Efficient tuning of COCOMO model cost drivers through generalized reduced gradient (GRG) nonlinear optimization with best-fit analysis. In Progress in Advanced Computing and Intelligent Engineering (pp. 347-354). Springer, Singapore

[72]. Seth, B., & Dalal, S. (2018). Analytical assessment of security mechanisms of cloud environment. In Progress in Advanced Computing and Intelligent Engineering (pp. 211-220). Springer, Singapore.

[73]. Kukreja, S., & Dalal, S. (2018). Performance analysis of cloud resource provisioning algorithms. In Progress in Advanced Computing and Intelligent Engineering (pp. 593-602). Springer, Singapore.

[74]. Rani, U., Dalal, S., & Kumar, J. (2018). Optimizing performance of fuzzy decision support system with multiple parameter dependency for cloud provider evaluation. Int. J. Eng. Technol, 7(1.2), 61-65.

[75]. Dahiya, N., Dalal, S., & Khatri, S. (2017). An Enhanced Bat Algorithm for Data Clustering Problems. International Journal of Advanced Research in Computer Science, 8(3).

[76]. Dahiya, N., Dalal, S., & Khatri, S. (2017). Data clustering and its Application to numerical function optimization algorithm. International Journal of Advanced Research in Computer Science, 8(1).

[77]. Arora, S., & Dalal, S. (2017). Adaptive Model For Integrity Verification In Cloud Computing System. International Journal of Advanced Research in Computer Science, 8(1), 233-236.

[78]. Neeraj Dahiya, S. (2017). Numerical Function Optimization: Model, Procedure And Uses. International Journal of Engineering Science and Technology (IJEST), 9(4), 266-270.

[79]. Dahiya, N., Dalal, S., & Khatri, S. (2016). Refinement with Image clustering using Self-Organizing Map and Numerical Function Optimization. International Journal of Computer Science and Information Security, 14(11), 909.

[80]. Neeraj Dahiya, S. (2016). A Review on Numerical function optimization Algorithm and its Applications to Data Clustering & Classification. International Journal of Recent Research Aspects, 3(3), 115-121.

[81]. Arora, S., & Dalal, S. (2016). Novel Approach of Integrity Verification in Dynamic Cloud Environment. International Journal of Computer Science and Information Security, 14(8), 207.

[82]. Dalal, S., & Kukreja, S. (2016). Genetic Algorithm based Novel approach for Load Balancing problem in Cloud environment. International Journal of computer science and information security, 14(7), 88.

[83]. Arora, S., & Dalal, S. (2016). Study of Integrity Based Algorithm in Decentralized Cloud Computing Environment. International Journal of Institutional & Industrial Research, 1(1), 15-17.

[84]. Vishakha, S. D. (2016). Performance Analysis of Cloud Load Balancing Algorithms. International Journal of Institutional and Industrial Research, 1(01), 1-5.

[85]. Dalal, S., & Jindal, U. (2016, March). Performance of integrated signature verification approach. In 2016 3rd International Conference on Computing for Sustainable Global Development (INDIACom) (pp. 3369-3373). IEEE.

[86]. Dahiya, N., Dalal, S., & Tanwar, G. (2016, March). Refining of image using self-organizing map with clustering. In AIP Conference Proceedings (Vol. 1715, No. 1, p. 020064). AIP Publishing LLC.

[87]. Dahiya, N., Dalal, S., & Khatri, S. (2016). A Review on Numerical function optimization Algorithm and its Applications to Data Clustering & Classification. International Journal of Recent Research Aspects, 3(3), 111-115.

[88]. Arora, S., & Dalal, S. (2016). Enhanced Privacy Preserving Access Control in the Cloud. International Journal of Recent Research Aspects, 3(4), 66-70.

[89]. Dahiya, N., Dalal, S., Khatri, S., & Kumar, Y. (2016). Cat Swarm Optimization: Applications And Experimental Illustrations To Data Clustering. International Journal of Control Theory and Applications, 9(41), 759-765.

[90]. Rani, U., & Dalal, S. (2016). Neural Network Applications in Design Process of Decision Support System. International Journal of Recent Research Aspects, 4(2), 40-44.

[91]. Seth, B., & Dalal, S. (2016). Designing Hybrid Security Architecture in Multi Cloud System. International Journal of Control Theory and Applications, 9(41), 767-776.

[92]. Seth, B., & Dalal, S. (2016). Analysis of cryptographic approaches. International Journal of Recent Research Aspect, 3(1), 21-24.

[93]. Jindal, U., & Dalal, S. (2016). Survey on Signature verification and recognition using SIFT and its variant. International Journal of Recent Research Aspects, 3(3), 26-29.

[94]. Sharma, D., Sharma, K., & Dalal, S. (2014). Optimized load balancing in grid computing using tentative ant colony algorithm. International Journal of Recent Research Aspects, 1(1), 35-39.

[95]. Jindal, K., Dalal, S., & Sharma, K. K. (2014, February). Analyzing spoofing attacks in wireless networks. In 2014 Fourth International Conference on Advanced Computing & Communication Technologies (pp. 398-402). IEEE.

[96]. Dalal, Surjeet & Srinivasan, S, Approach of multi agent system in controlling bullwhip effect of supply chain management system using case based reasoning, Department of Computer Science, Suresh Gyan Vihar University, 20/01/2014, http://hdl.handle.net/10603/36464

[97]. Sharma, S., & Dalal, S. (2014). Recognition and identification schemes for the development of Eigen feature extraction based iris recognition system. International Journal of Recent Research Aspects ISSN, 2349-7688.

[98]. Sharma, P., Sharma, K., & Dalal, S. (2014). Preventing Sybil Attack in MANET using Super nodes approach. International Journal of Recent Research Aspects, 1(1), 30-34.

[99]. Simi Gupta, D., & Dalal, S. (2014). Efficient broker scheduling in Cloud Computing. International Journal of Recent Research Aspects, 1(2), 74-77.

[100]. Sharma, S., & Dalal, S. (2014). Feature Recognition from Histogram and Eigen Algorithm in Digital Image Processing.

[101]. Mittal, A., & Dalal, S. (2014). Implying p-Cure algorithm in case retrieval stage of the case-based reasoning. International Journal of Recent Research Aspects, 3(3), 91-98.

[102]. Mittal, A., Sharma, K. K., & Dalal, S. (2014). Approach of BPEL in supply chain activities for managing bullwhip effect of SCM system. Int. J. Res. Asp. Eng. Manag, 1(2), 26-30.

[103]. Sharma, P., & Dalal, S. (2014). Shortest Path Algorithms Technique for Nearly Acyclic Graphs. International Journal of Recent Research Aspects, 3(3), 36-39.

[104]. Dalal, S., Jaglan, V., & Sharma, K. K. (2014). Designing architecture of demand forecasting tool using multi-agent system. International Journal of Advanced Research in Engineering and Applied Sciences, 3(1), 11-20.

[105]. Sheikh, M., Sharma, K., & Dalal, S. (2014). Efficient method for WiMAX soft handover in VOIP and

IPTV. International Journal of Research Aspects of Engineering & Management, 1(2), 5-48.

[106]. Kumar, S., & Dalal, S. (2014). Optimizing Intrusion Detection System using Genetic Algorithm. International Journal of Research Aspects of Engineering and Management ISSN, 2348-6627.

[107]. Mittal, A., Sharma, K. K., & Dalal, S. (2014). Applying clustering algorithm in case retrieval phase of the case-based reasoning. International Journal of Research Aspects of Engineering and Management, 1(2), 14-16.

[108]. Dalal, S., Jaglan, V., & Sharma, K. K. (2014). Integrating Multi-case-base-reasoning with Distributed case-based reasoning. International Journal of Advanced Research in IT and Engineering ISSN, 2278-6244.

[109]. Saini, A., Sharma, K. K., & Dalal, S. (2014). A survey on outlier detection in WSN. International Journal of Research Aspects of Engineering and Management ISSN, 2348-6627.

[110]. Sharma, P., Sharma, D. K., & Dalal, S. (2014). Preventing Sybil Attack In MANET Using Super Node Using Approach. International Journal of Recent Research Aspects, ISSN, 2349-7688.

[111]. Chahar, P., & Dalal, S. (2013). Deadlock resolution techniques: an overview. International Journal of Scientific and Research Publications, 3(7), 1-5.

[112]. Dalal, Surjeet, Keshav Jindal, and Monika Nirwal. "Developing Flexible Decision Support Systems Using Case-Base Reasoning System." International Journal of Engineering and Management Research (IJEMR) 3.4 (2013): 13-17.

[113]. Dalal, S., & Sharma, K. K. (2013). Simulating supply chain activities in multi-agent based supply chain management system with plasma simulator. International journal of Computer Science & Communication, 4(1), 80-85.

[114]. Dalal, S., Tanwar, G., & Alhawat, N. (2013). Designing CBRBDI agent for implementing supply chain system. system, 3(1), 1288-1292.

[115]. Dalal, S., & Athavale, V. (2012). Challenging Bullwhip Effect of Supply Chain Through Case Based Multi Agent System: A Review. International Journal of Advanced Research in Computer Science and Software Engineering, 2(12), 267-272.

[116]. Dalal, S., Tanwar, G., & Jindal, K. (2012). Agent Oriented Programming In Trading System Automation. International Journal of Research in IT, Management and Engineering, 2(8), 51-59.

[117]. Dalal, Surjeet, and Vijay Athavale. "Analysing Supply Chain Strategy Using Case-Based Reasoning." Journal of Supply Chain Management Systems 1.3 (2012).

[118]. Jindal, K., Dalal, S., & Jaglan, V. (2012). Comparative Study On IEEE 802.11 Wireless Local Area Network Securities. International Journal of Advanced Research in Computer Science, 3(1).

[119]. Jindal, K., Dalal, S., & Tanwar, G. (2012). Congestion Control Framework in Ad-Hoc Wireless using Neural Networks in QoS. International Journal of Research in Computer Engineering and Electronics, ISSN, 15-18.

[120]. Dalal, S., Athavale, V., & Jindal, K. (2012). Designing Case-based reasoning applications with Colibri Studio. International Journal of Research in Computer Engineering and Electronics, 1(1), 15-18.

[121]. Jaglan, V., Dalal, S., & Srinivasan, S. (2011). Improving performance of business intelligence through case based reasoning. International Journal of Engineering Science and Technology, 3(4), 2880-2886.

[122]. Jaglan, V., Dalai, S., & Srinivasan, S. (2011). Enhancing security of agent-oriented techniques programs code using jar files. International Journal on Computer Science and Engineering, 3(4), 1627-1632.

[123]. Dalal, S., Athavale, V., & Jindal, K. (2011). Case retrieval optimization of Case-based reasoning through Knowledge-intensive Similarity measures. Int. J. Comput. Appl, 34(3), 12-18.

[124]. Surjeet Dalal, V., & Kumar, S. (2010). Designing of business tool using intelligent agent. In National Conference Advanced Computing & Communication tech ACCT (pp. 751-754).

[125]. Mokhtar SA, Elsayad A. Predicting the severity of breast masses with data mining methods. *ArXiv preprint arXiv:1305* . 7057 2013 doi: 10.48550/ARxIV.1305.7057. [CrossRef] [Google Scholar]

