Development of Breast Cancer Diagnosis System

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ORIGINAL RESEARCH

Abstract— Breast cancer poses a global health challenge, necessitating advanced diagnostic system for improved patient outcomes. This study introduces the Breast Cancer Diagnosis System (BCDS), employing sophisticated programming languages such as JavaScript, React and Python to develop an advanced expert system for a swift and precise breast cancer diagnosis. Emphasizing accuracy, early detection and informed decision-making. BCDS addresses the intricate nature of breast cancer diagnosis. Its comprehensive solution harnesses the capabilities of powerful programming languages to prioritize efficiency and precision, aiming to enhance the diagnostic process for healthcare professionals. Rigorous testing ensures the reliability of independent modules, logical decisions, and data validation. BCDS demonstrates promising outcomes with a user friendly landing page and clear operational guide. This system emerges as a valuable contribution to healthcare technology, addressing the complexities of breast cancer diagnosis and care, thereby signifying a significant stride in breast cancer diagnostic systems and underscoring the ongoing need for advancements in healthcare technology. In furthering this study, expanding validation studies by incorporating larger and more diverse dataset in tackling complex challenges on breast cancer would help in creating more awareness for early detection.

Keywords— Breast cancer, Breast Cancer Diagnosis System (BCDS), Early detection and Healthcare professionals.

1 INTRODUCTION

Breast cancer, a complex and potentially life-threatening condition affecting both women and men, stands as a significant global health challenge. It is one of the most leading causes of death among women in Nigeria and the world at large. In 2008, 182,460 new cases of invasive breast cancer in women and 1,990 new cases found in men were being reported (Bray *et al.,* 2018). The number of breast cancer cases is estimated to have reached 1.2 million worldwide. Globally every 3 minutes, a woman is diagnosed with breast cancer amounting to 1 million annually.

The World Health Organization estimates that about 250,000 cases of breast cancer are seen each year in Nigeria, of these, nearly 10,000 deaths occur annually (Okobia *et al.,* 2006). The Nigeria government sought to address the breast cancer issue by establishing cancer registries within the Department of Pathology at the university College Hospital in Ibadan. To enhance healthcare delivery services, the Federal Ministry of Health formed a committee to develop a National Cancer Policy following the 2006 World Cancer Congress, (Adetifa and Ojikutu, 2009). However, by 2007, when the federal government inaugurated the National Commission on Cancer Control and introduced a National Policy on Reproductive Health and Strategic Framework, none of the proposed measures had been implemented.

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Breast cancer encompasses several types and subtypes, each characterized by distinct features that influence treatment approaches and patient outcomes. These types include invasive breast cancer, which involves cancer cells penetrating and spreading into surrounding breast tissue, and non-invasive breast cancer, where the cancer remains confined within the original breast tissue (Acs *et al.,* 2024) (Nair *et al.,* 2018). Invasive breast cancer includes subtypes such as Invasive Ductal Carcinoma (IDC), originating in the milk ducts, and Invasive Lobular Carcinoma (ILC), arising from the lobules as seen in Figs. 1a and 1b (Yang *et al.,* 2020).

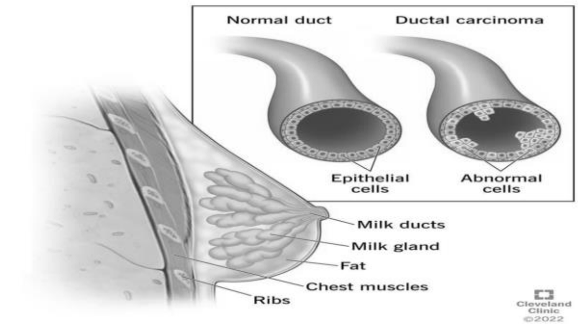

Fig. 1a. Visual Depiction of Invasive Ductal Carcinoma Breast Cancer

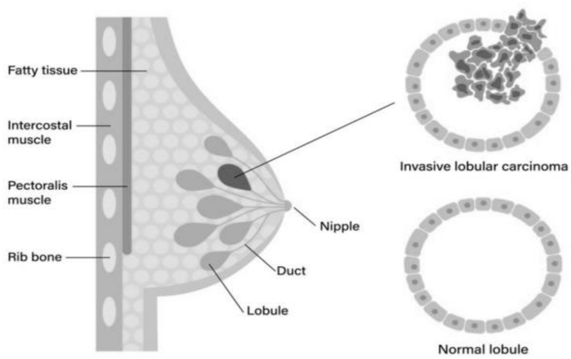

Fig. 1b. Visual Depiction of Invasive Lobular Carcinoma Breast Cancer

Traditional diagnostic methods, including physical examinations, imaging techniques like mammography, and tissue biopsy analyses, while valuable, often rely heavily on medical expertise and may be subject to interpretation bias. Moreover, delays or inaccuracies in diagnosis can lead to adverse treatment outcomes and increased patient distress. Consequently, there's a pressing need for more efficient and accessible diagnostic approaches (Arnold *et al.*, 2022) (Sung *et al.*, 2021) (Wilkinson and Gathani, 2022).

Additionally, there are aggressive forms like Triple-Negative Breast Cancer and Inflammatory Breast Cancer, along with metastatic and recurrent breast cancer. Male Breast Cancer and Paget Disease of the Breast are also recognized types. Non-invasive breast cancer types include Ductal Carcinoma in Situ (DCIS) and Lobular Carcinoma in Situ (LCIS), which play crucial roles in guiding medical decisions and treatment strategies (Yang *et al.*, 2020).

In recent years, advancements in artificial intelligence (AI) and machine learning have provided new opportunities in various industries, including healthcare. Expert systems, computer-based programs that simulate human decision-making abilities, have emerged as promising tools in medical diagnosis and treatment planning. By incorporating domain-specific knowledge and reasoning methods, these systems can complement the expertise of healthcare professionals and provide valuable insights for precise diagnosis and treatment strategies (Ferlay *et al.*, 2019). However, developing a dependable and highly accurate expert system for breast cancer diagnosis poses formidable challenges, including ensuring reliability, safety, and adherence to medical ethics (Barrios, 2022).

This study develops an expert system for breast cancer diagnosis using the PyKnow library in Python, incorporating knowledge of the diverse types and subtypes. The central objective is to create a user-friendly and dependable system capable of delivering accurate diagnostic outcomes. Leveraging advanced technologies such as artificial intelligence and machine learning, the study seeks to streamline the diagnostic process, potentially reducing timelines and improving the prospects of early breast cancer detection and successful treatment.

2 Review of Related Works

Several studies have contributed to the advancement of breast cancer diagnosis through the development of expert systems and decision-support tools (Singh *et al.*, 2010) achieved notable success with an expert system for breast cancer diagnosis, attaining an AUC of 0.83, comparable to neural network models. The approach aimed to enhance mammography accuracy, provide decision support for clinicians, and reduce unnecessary biopsies. However, highlighted limitations concerning sensitivity to hardware and software parameters, urging careful consideration for clinical implementation was discovered.

Research conducted, far back as 19th century that breast cancer was given serious attention from the medical community, when first surgical removal of lymph nodes, breast tissue and chest muscle as the first successful treatment of breast cancer was when improvement in sanitation and disease control dramatically increased the lifespan of women (Suchy *et al.*, 2013) .

Furthering the research by assessing the likelihood of breast cancer occurrence through mammography feature analysis. The work emphasized key considerations in expert system design, including feature selection, knowledge base establishment, and rule-based reasoning techniques which laid the groundwork for improving diagnostic accuracy and decision support in breast cancer screening (Singh *et al.*, 2017).

Samah El samaney, used breast imaging reporting data system (BI-RADS) and Samah mammography datasets (SMDs) to classify images to help doctors in early detection and to reduce treatment cost and result of this work shows that the technique used generated 82.5% accuracy. However, the scope of the research was limited to hospitals in Sudan alone, and cannot be used to predict reduction in breast cancer mortality worldwide (Mohamed *et al.*, 2018).

Introduction of an innovative approach using Computer-Aided Diagnosis (CAD) expert systems was developed, focusing on machine learning techniques, particularly deep learning, for analyzing histopathology images. The work extensively reviewed the strengths and weaknesses of traditional and deep learning methods, addressing challenges in real-world implementation which underscored the potential of deep learning in CAD systems but emphasized the need for expert interpretation and addressing technical and regulatory hurdles (Liew *et al.*, 2021).

Research testing was presented on breast cancer diagnosis system, still in its validation stage. The system aimed to enhance diagnostic accuracy and reduce uncertainty by providing a quantitative hazard index. While promising for early cancer detection, further validation with larger datasets and independent sets is needed to establish reliability (Casal-Guisande *et al.*, 2022).

This study introduced an enhanced treatment algorithm (an updated Austrian treatment algorithm) for addressing metastatic triple-negative breast cancer (mTNBC) in Austria. This updated algorithm offers a detailed assessment of the clinical risks and benefits associated with various mTNBC therapies. Additionally, the report explores the role of sacituzumab in mTNBC treatment. It underscores the ongoing importance of research and development efforts in this specific area of breast cancer management (Bartsch *et al.*, 2023).

The latest related work by (Casal-Guisande *et al.*, 2023) proposed an intelligent clinical decision support system for breast cancer screening and diagnosis. This system integrates inferential models to define patient risk metrics and derive a Global Risk value, enhancing diagnostic

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accuracy and efficiency. The study demonstrated significant disease detection rates, indicating potential diagnostic application and offering personalized risk assessment for improved treatment outcomes. The study stands out as it integrates advanced inferential models into a clinical decision support system, offering personalized risk assessment and potentially enhancing diagnostic accuracy and treatment outcomes in breast cancer diagnosis.

3 Methods

BCDS employs specialized breast ontology inputs and the PyKnow library to develop an expert system, facilitating precise breast cancer diagnosis based on clinical data to enhance community awareness, enable early diagnosis, and provide treatment guidance through a user-friendly web application using React.js, integration of specialized ontology, and thorough testing for algorithm accuracy. Ethical considerations, feedback mechanisms, and deployment for healthcare professionals and the community are integral components, ensuring ongoing support and future enhancements. Fig. 3 shows system architecture which is established upon a collection of pivotal elements, their interconnections, and their interfaces with other systems.

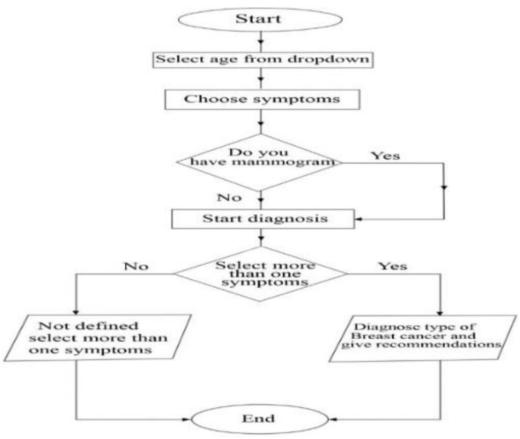

Fig. 3. System Architecture of BCDS

3.1 Overview of Bcds

The BCDS overview seen in Fig. 4 in the dataflow user interaction, where age and symptoms are input, potentially leading to a mammogram based on risk factors. Fig. 5 presents the sequence flow showcasing interaction between user input such as age, symptoms and optional mammogram guide and system process.

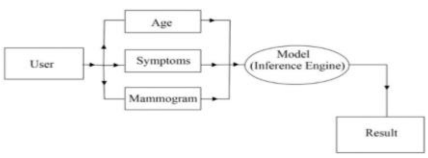

Fig. 4. BCDS System Dataflow

User update the system regularly by pressing "diagnose" that initiate analysis, retrieve diagnosis and recommendation. Fig. 6 displays the BCDS component through an activity diagram, illustrating the flow and sequencing of activities within the system. It highlights the user-led journey, from input selection to the display of diagnosis and recommendations which provides a clear overview of the system's navigation and functionality.

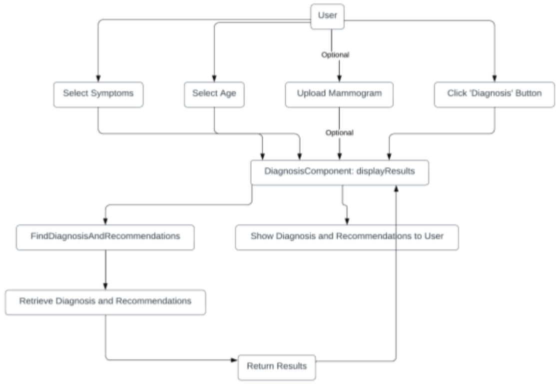

Fig. 5. The sequence diagram for the proposed BCDS

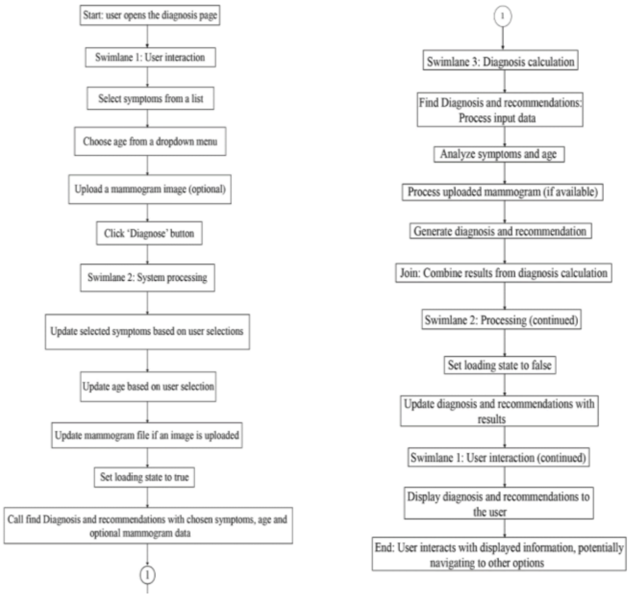

Fig. 6. Activity diagram for BCDS

3.2 Some Ionic Framework: Inbuilt Function and Custom Function Development

The module React. js-based implementation for BCDS focused on obtaining a diagnosis based on selected symptoms and optional mammogram inputs. Appendix 1 encompasses a segment of source code, offering a glimpse into the implementation details of a React.js module designed for BCDS which appears to focus on user interface elements and functional components pertinent to the diagnosis process.

The lines of codes declare state variables using the '***useState***' hook which manages the selected symptoms, diagnosis result, recommendations result, and loading status of the diagnosis process. and the function '***handleSymptomChange***' toggles the selection of symptoms when a checkbox input is changed. It efficiently manages the selection of symptoms in response to user interaction with the checkbox inputs, providing a seamless user experience in symptom selection within the diagnosis form.

The '***handleDiagnosisButtonClick***' initiates the diagnosis process when the diagnosis button is clicked. It encapsulates the logic for initiating the diagnosis process, managing the loading state, fetching diagnoses and recommendations, and updating the UI with the results. This ensures a smooth user experience by providing feedback during the diagnosis process and displaying the results once they are available, the source code can be seen in Appendix 1 parts A and B.

Fig. 7 shows the ***'findDiagnosisAndRecommendations'*** find the diagnosis and recommendations based on selected symptoms. This determines the diagnosis and recommendations based on the selected symptoms by comparing them with predefined symptom sets stored in ***symptomData.*** plays a crucial role in the diagnosis process within the application, providing accurate information to the user based on their input symptoms.

```
const fileInputRef = useRef(null);

    const handleHiddenInputClick = () => {
        fileInputRef.current.click();
    };

    const handleFileInputChange = (event) => {
        const fileList = event.target.files;
        // Handle the file list as needed, e.g., upload or process the files
        console.log(fileList);
    };
```

Fig. 7. The ***findDiagnosisAndRecommendations*** Hook

Lastly, Fig. 8 represents ***'handleHiddenInputClick'*** triggers the file selection dialogue when the hidden input is clicked. It provides a seamless user experience by allowing users to interact with custom-styled elements to trigger the file selection dialogue and the ***'handleFileInputChange'*** is responsible for processing file input changes when a file is selected. It also processes the selected files, enabling the application to respond appropriately to the user's file selections, such as uploading files for further processing or displaying file-related information to the user.

```
const findDiagnosisAndRecommendations = (selectedSymptoms) => {


    // Convert selected symptoms to a set for easier comparison
    const selectedSet = new Set(selectedSymptoms);

    // Find matching symptom set in symptomData
    const matchedSymptomSet = symptomData.find((item) =>
      item.symptoms.every((symptom) => selectedSet.has(symptom))
    );

    // Return diagnosis and recommendations if a match is found
    return matchedSymptomSet
      ? { diagnosis: matchedSymptomSet.diagnosis, recommendations: matchedSymptomSet.recommendations }
      : { diagnosis: 'Not definite!', recommendations: ['Select more symptoms'] };
};
```

Fig. 8. The ***handleFileInputChange*** & ***handleHiddenInputClick*** Hooks

4 DISCUSSION AND RESULT

The application user interface of BCDS is discussed in stages:

i. Landing page serves as the first interaction for users upon launching the web application, presenting an interface that seamlessly blends attractiveness with user-friendliness. It shows the pages comprised 'About the breast Cancer page that gives key insights into breast cancer for healthcare professionals and the wider community and displays fundamental knowledge, symptoms, and characteristics of different types, fostering awareness, early detection, and empowering users with a comprehensive understanding upon login in into the application and 'Get familiar with some symptoms page, empowers individuals to recognize key indicators and take proactive steps for breast health. The user-friendly layout ensures accessibility, fostering a sense of understanding for those who do not have prior knowledge of the condition.
ii. The Get a Diagnosis page facilitates user input for accurate breast cancer diagnosis. With an intuitive interface, users select symptoms, input age, and optionally upload mammogram data. The system processes this information, providing precise diagnosis results and recommendations for ductal carcinoma in Situ breast cancer or triple-negative breast cancer or when a user has just one symptom.
iii. The Give us feedback on how we can serve You Better page is where users can share thoughts and suggestions for the continuous improvement of BCDS. It encourages user input to enhance the system based on their experience, ensuring a more tailored and effective user interaction. The visual representation of all the described application interfaces can be seen in Appendix 2.

5 CONCLUSION

The BCDS project embodies a significant leap in healthcare technology, particularly within breast cancer management, driven by AI and expert systems. Its innovative approach excels in analyzing diverse data, offering personalized treatment insights, and augmenting diagnostic accuracy. The study successfully developed a user friendly and informative breast cancer diagnosis support system, featuring structured and logically organized content for enhanced navigation and knowledge acquisition. It empowers users through guided symptom based pathway, complemented by feedback mechanism, for continuous improvement. Future work connecting BCDS to more medical records for improved coordination, broader accessibility and addressing the emotional impact through psychological support resources. Addressing this aspect can enhance BCDS as a potent tool for breast cancer awareness, early detection and informed decision-making.

REFERENCES

Acs, B., Hartman, J., Sönmez, D., Lindman, H., Johansson, A. L., & Fredriksson, I. (2024). Real-world overall survival and characteristics of patients with ER-zero and ER-low HER2-negative breast cancer treated as triple-negative breast cancer: a Swedish population-based cohort study. *The Lancet Regional Health–Europe, 40*.

Adetifa, F., & Ojikutu, R. K. (2009). Prevalence and trends in breast cancer in Lagos State, Nigeria. *African Research Review, 3*(5).

Arnold, M., Morgan, E., Rumgay, H., Mafra, A., Singh, D., Laversanne, M., . . . Siesling, S. (2022). Current and future burden of breast cancer: Global statistics for 2020 and 2040. *The Breast, 66*, 15-23.

Barrios, C. H. (2022). Global challenges in breast cancer detection and treatment. *The Breast, 62*, S3-S6.

Bartsch, R., Rinnerthaler, G., Petru, E., Egle, D., Gnant, M., Balic, M.,

http://dx.doi.org/10.46792/fuoyejet.v9i2.10 engineering.fuoye.edu.ng/journal

. . . Singer, C. (2023). Updated Austrian treatment algorithm for metastatic triple-negative breast cancer. *Wiener klinische Wochenschrift*, 1-15.

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.

Casal-Guisande, M., Álvarez-Pazó, A., Cerqueiro-Pequeño, J., Bouza-Rodríguez, J.-B., Peláez-Lourido, G., & Comesaña-Campos, A. (2023). Proposal and definition of an intelligent clinical decision support system applied to the screening and early diagnosis of breast cancer. *Cancers, 15*(6), 1711.

Casal-Guisande, M., Comesaña-Campos, A., Dutra, I., Cerqueiro-Pequeño, J., & Bouza-Rodríguez, J.-B. (2022). Design and development of an intelligent clinical decision support system applied to the evaluation of breast cancer risk. *Journal of personalized medicine, 12*(2), 169.

Ferlay, J., Colombet, M., Soerjomataram, I., Mathers, C., Parkin, D. M., Piñeros, M., . . . Bray, F. (2019). Estimating the global cancer incidence and mortality in 2018: GLOBOCAN sources and methods. *International journal of cancer, 144*(8), 1941-1953.

Liew, X. Y., Hameed, N., & Clos, J. (2021). A review of computer-aided expert systems for breast cancer diagnosis. *Cancers, 13*(11), 2764.

Mohamed, S., Wahbi, T., & Sayed, M. (2018). Automated detection and classification of breast cancer using mammography images. *International Journal of Science, Engineering and Technology Research (IJSETR), 7*(4).

Nair, N., Shet, T., Parmar, V., Havaldar, R., Gupta, S., Budrukkar, A.,. . . Yadav, P. (2018). Breast cancer in a tertiary cancer center in India-An audit, with outcome analysis. *Indian journal of cancer, 55*(1), 16-22.

Okobia, M. N., Bunker, C. H., Okonofua, F. E., & Osime, U. (2006). Knowledge, attitude and practice of Nigerian women towards breast cancer: a cross-sectional study. *World journal of surgical oncology, 4*, 1-9.

Singh, E., Joffe, M., Cubasch, H., Ruff, P., Norris, S., & Pisa, P. (2017). Breast cancer trends differ by ethnicity: a report from the South African National Cancer Registry (1994–2009). *The European Journal of Public Health, 27*(1), 173-178.

Singh, T., Bhadauria, S., Wadhwani, S., & Wadhwani, A. (2010). Design issues of expert system for breast cancer detection. *International Journal of Information Studies, 3*(1), 198-204.

Suchy, S. L., Landreneau, R. J., Schuchert, M. J., Wang, D., Ervin Jr, P. R., & Brower, S. L. (2013). Adaptation of a chemosensitivity assay to accurately assess pemetrexed in ex vivo cultures of lung cancer. *Cancer biology & therapy, 14*(1), 39-44.

Sung, H., Ferlay, J., Siegel, R. L., Laversanne, M., Soerjomataram, I., Jemal, A., & Bray, F. (2021). Global cancer statistics 2020: GLOBOCAN estimates of incidence and mortality worldwide for 36 cancers in 185 countries. *CA: a cancer journal for clinicians, 71*(3), 209-249.

Wilkinson, L., & Gathani, T. (2022). Understanding breast cancer as a global health concern. *The British journal of radiology, 95*(1130), 20211033.

Yang, C., Lei, C., Zhang, Y., Zhang, J., Ji, F., Pan, W., . . . Li, J. (2020). Comparison of overall survival between invasive lobular breast carcinoma and invasive ductal breast carcinoma: a propensity score matching study based on SEER database. *Frontiers in Oncology, 10*, 590643.

6 APPENDICES

6.1 APPENDIX 1: SYSTEM SOURCE CODE (PART A)

```
c > pages > JS Diagnosis.js > ...
import React, { useState,useRef } from "react";
import Header from "../components/header/Header";
import Footer from "../components/footer/Footer";

import Button from "../components/Button";
import headerBg from "../assets/diag-header-bg.png";
import diagnosisBg from "../assets/diagnosis2-bg.png";
import info from "../assets/inform.svg";
import add from "../assets/add.svg";
import arrow from "../assets/arrow-right.svg"

const Diagnosis = () => {
    const [selectedSymptoms, setSelectedSymptoms] = useState([]);
    const [diagnosisResult, setDiagnosisResult] = useState('');
    const [recommendationsResult, setRecommendationsResult] = useState('');
      const [loading, setLoading] = useState(false);

    const symptomData = [
        {
          symptoms: ['Lump or Mass', 'Nipple Change', 'Skin change'],
          diagnosis: ['The type of breast cancer you have is: Ductal Carcinoma In Situ (DCIS)'],
          recommendations: ['It is not the end of the world, my dear.', 'These are some procedures:', '- Lumpectomy (removal of the tumor)', '
        },
        {
          symptoms: ['Thickening or swelling in breast', 'Skin changes'],
          diagnosis: 'The type of breast cancer you have is: Invasive Ductal Carcinoma (IDC) ',
          recommendations: ['It is not the end of the world, my dear.', 'These are some procedures:', '- Surgery (lumpectomy or mastectomy)',
        },
        {
            symptoms: ['changes in breast appearance', 'Swelling',],
            diagnosis: 'The type of breast cancer you have is: Invasive Lobular Carcinoma (ILC)',
            recommendations: ['It is not the end of the world, my dear.', 'These are some procedures:', '- Hormone therapy', '- Chemotherapy',
        },
        {
            symptoms: ['Breast lump or mass', 'Skin changes (redness, dimpling)', 'Breast Pain'],
            diagnosis: 'The type of breast cancer you have is: Triple-Negative Breast Cancer',
            recommendations: ['It is not the end of the world, my dear.', 'These are some procedures:', '- Immunotherapy (in some cases)', '-
        },
        {
            symptoms: ['Breast lump', 'Breast Mass', 'Skin colour changes (redness, dimpling)',],
            diagnosis: 'The type of breast cancer you have is: HER2-Positive Breast Cancer ',
```

6.2 APPENDIX 1: SYSTEM SOURCE CODE (PART B)

```
            diagnosis: 'The type of breast cancer you have is: HER2-Positive Breast Cancer ',
            recommendations: ['It is not the end of the world, my dear.', 'These are some procedures:', '- Targeted therapy (anti-HER2 drugs)'
        },

        {
            symptoms: ['Breast Mass and Lump', 'Nipple changes (inversion or discharge)',],
            diagnosis: 'The type of breast cancer you have is: Hormone Receptor-Positive Breast Cancer',
            recommendations: ['It is not the end of the world, my dear.', 'These are some procedures:', '- Hormone therapy (tamoxifen, aromata

    ];



    const handleSymptomChange = (event) => {
        const { value } = event.target;

        // Toggle the selected symptom
        setSelectedSymptoms((prevSelected) =>
          prevSelected.includes(value)
            ? prevSelected.filter((s) => s !== value)
            : [...prevSelected, value]
        );
    };

    const handleDiagnosisButtonClick = () => {
        setLoading(true);
        // Logic to find diagnosis and recommendations based on selected symptoms

        setTimeout(() => {
            const { diagnosis, recommendations } = findDiagnosisAndRecommendations(selectedSymptoms);

            // Update state to display the result
            setDiagnosisResult(diagnosis);
            setRecommendationsResult(recommendations);

            setLoading(false)
        }, 2000)


    };
```

6.3 APPENDIX 2: BCDS APPLICATION

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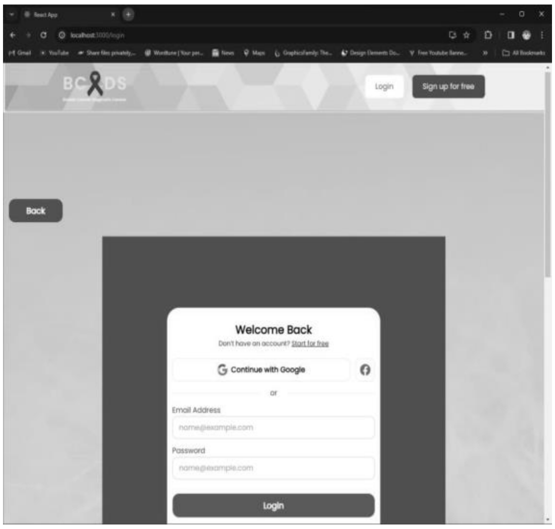
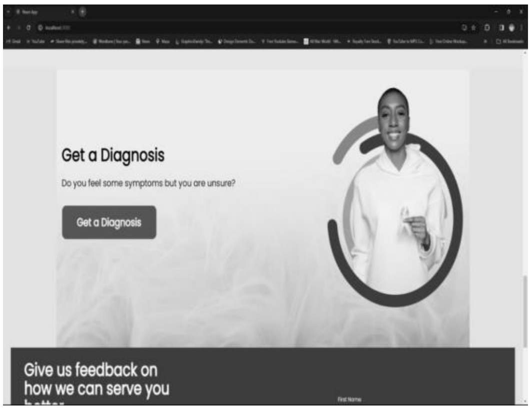
INTERFACE

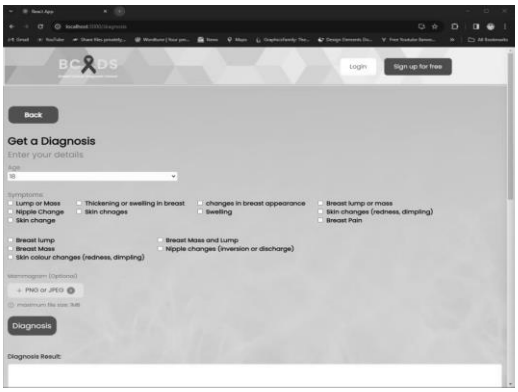
Landing Page



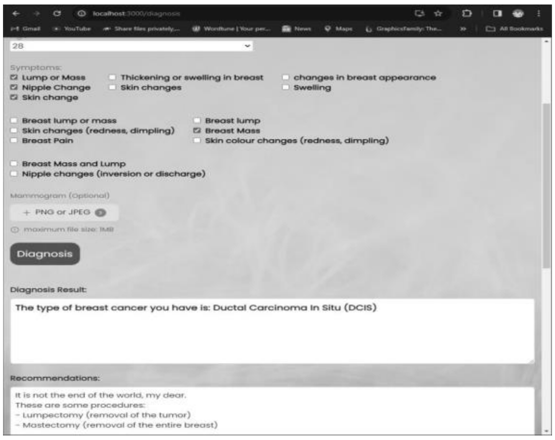
Login Page



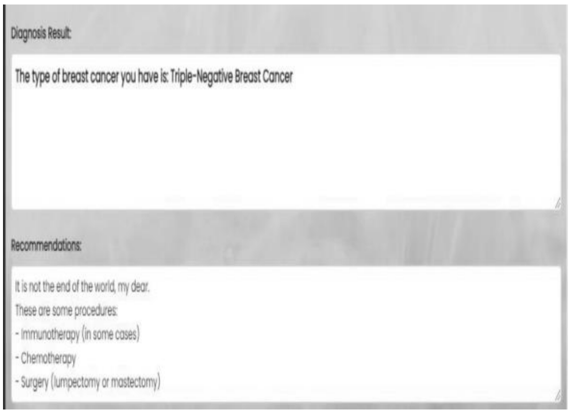
Get a Diagnosis Prompt



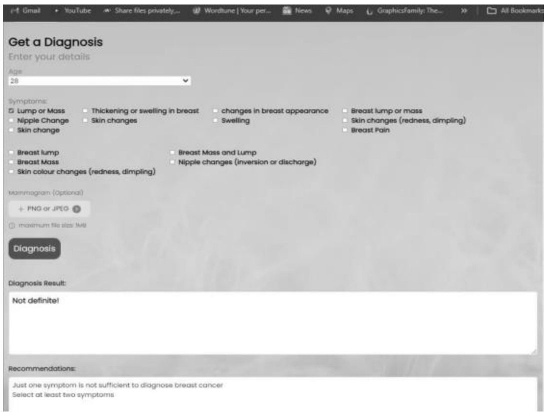
Get a Diagnosis Page



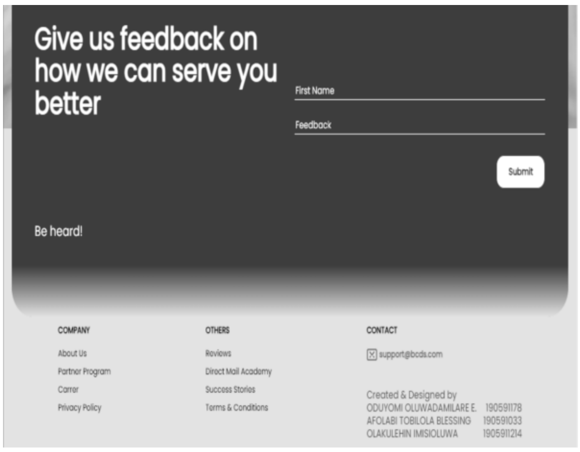
Results and Recommendations Diagnosing a User of Ductal Carcinoma in Situ Breast Cancer



Other Results and Recommendations for Diagnosing a User of Triple-Negative Breast Cancer



Result and Recommendations When User Chose One Symptom



Section to Get Feedback from Users to Know How to Improve the System