INTEGRATED BREAST HEALTH MANAGEMENT PLATFORM

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Abstract: An innovative platform to revolutionize breath health management. User enters their symptoms into a website or mobile application, receiving real-time risk assessments. Non-cancerous cases are reassured, while potential malignancies prompt hospital recommendations. The platform facilitates appointment bookings and seamless data transfer to partnered hospitals. Employing advanced machine learning, our system analyzes mammograms, generating accurate reports for informed diagnosis. This report encapsulates the platform's objective, operational features, successful outcomes, and pivotal conclusions. This pioneering solution that amalgamates technology, medical expertise, and patient-centricity for enhanced breast health management.

1. Problem Statement

Breast cancer, the most prevalent form of cancer affecting women globally, is an escalating public health concern. Constituting approximately 30% of all new female cancer cases each year, its pervasive impact persists despite advancements in research and treatment modalities. A significant challenge lies in the widespread occurrence of breast cancer, often reaching alarming levels in specific demographic groups. While survival rates have seen improvement, late detection remains a critical issue, compromising treatment efficacy.

Adding to the complexity is the underrecognized fact that breast cancer also affects men, constituting about 0.5–1% of all breast cancer cases. This often-overlooked aspect further amplifies the urgency for heightened awareness, as men may face challenges in early recognition and timely access to appropriate care. Insufficient awareness, coupled with the asymptomatic nature of early-stage breast cancer and the lack of routine screenings, contributes to delayed diagnoses, particularly in men where the condition may go unnoticed. Late-stage detection, extending beyond localized forms, exacerbates the danger, as interventions become less effective.

Addressing these multifaceted challenges demands innovative strategies to enhance early detection, improve awareness across genders, and ensure timely interventions. Bridging gaps in knowledge, accessibility, and personalized healthcare is essential for minimizing the impact of breast cancer on individuals and communities worldwide.

Fig 1. Global Stat. (F)

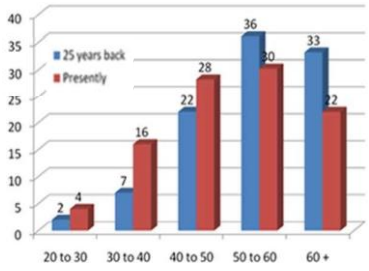

Fig 2. India's Stat. (F)

Fig 3. Stat. for Men

	Men	Women
Incidence rate (new cases per year)	1.1 per 100,000	118.8 per 100,000
Mortality rate (deaths per year)	0.3 per 100,000	19.1 per 100,000

Table 1. Incidence and Mortality Rate

2. Market/Customer/Business Need Assessment

2.1. Market Need:

2.1.1. Convenience and Accessibility:

There's a growing demand for convenient and accessible breast cancer screening options, allowing individuals to perform screenings in the comfort of their homes, eliminating the need for clinic visits.

2.1.2. Early Detection Emphasis:

The market recognizes the critical importance of early breast cancer detection.

Technologies that facilitate early screening can contribute significantly to improved outcomes and reduced mortality rates.

2.1.3. Inclusivity for Diverse Demographics:

The market emphasizes the need for breast health solutions that are inclusive of diverse demographic groups, considering factors such as age, ethnicity, and socioeconomic backgrounds.

2.2 Customer Need:

2.2.1 User-Friendly Technology:

Customers seek user-friendly and easy-to-use technologies that empower them to take charge of their breast health without the need for specialized knowledge or assistance.

2.2.2 Clear and Comprehensive Information:

Customers value clear and comprehensive information provided throughout the screening process, addressing doubts and concerns and fostering a supportive environment.

2.2.3 Home Comfort:

The ability to conduct breast cancer screenings at home aligns with customers' preference for comfort, reducing the barriers associated with traditional clinic-based screenings.

2.2.4 Affordability and Accessibility:

Customers are interested in affordable solutions that enhance accessibility, making breast cancer screening available to a broader demographic, including those with limited resources.

2.3 Business Need:

2.3.1 Product Innovation:

There is a business need for continuous product innovation, leveraging technology to enhance the effectiveness and user experience of breast cancer home screening solutions

2.3.2 Partnerships and Collaborations:

Establishing partnerships with healthcare institutions, professionals, and technology experts is crucial to ensure the credibility, accuracy, and regulatory compliance of the home screening technology.

2.3.3 Market Education and Awareness:

Businesses must invest in education and awareness initiatives to inform the market about the benefits of home-based breast cancer screening, dispelling myths and promoting early detection.

2.3.4 Customer Support and Engagement:

Providing robust customer support and engagement mechanisms is vital to build trust, address customer queries, and maintain a positive user experience throughout the

screening journey.

3. Target Specifications and Characterization

3.1. Target Specifications:

3.1.1. Home Screening Kit:

Self-Administered Tests: Developing a home screening kit that is easy to use, allowing individuals to collect samples comfortably and accurately at home.

3.1.2. Technological Interface:

Intuitive App Interface: Creating a user-friendly mobile or web application that guides users through the screening process step by step, providing clear instructions and visual aids.

3.1.3. Privacy and Data Security:

Secure Data Handling: Implementing robust privacy measures to ensure secure handling of personal health data, addressing concerns related to confidentiality and data security.

3.1.4. Multilingual Support:

Language Inclusivity: Offering multilingual support to accommodate individuals with diverse linguistic backgrounds, enhancing accessibility and understanding.

3.1.5. Educational Resources:

In-App Education: Integrating educational resources within the application to empower users with information about breast health, the importance of early detection, and guidance on the next steps after screening.

3.1.6. Affordability and Accessibility:

Cost-Effective Solutions: Striving to create an affordable home screening solution to enhance accessibility for a wide range of users, with considerations for insurance coverage or assistance programs.

3.1.7. Customer Support Services:

Responsive Customer Support: Establishing a dedicated customer support system to address queries, concerns, and provide assistance throughout the screening journey.

3.1.8. Results Communication:

Clear Results Communication: Designing a communication system that delivers screening results in a clear and understandable manner, including guidance on the recommended next steps.

3.2. Customer Characterization:

3.2.1. Demographics:

Age Range: Primarily targeting individuals aged 40 and above, with a focus on those within the median age of breast cancer diagnosis.

Gender Inclusivity: Catering to both women and men to address the varied screening needs across genders.

Socioeconomic Background: Designing solutions that are affordable and accessible to a broad spectrum of socioeconomic backgrounds

3.2.2. Geographic Considerations:

Urban and Rural Accessibility: Ensuring accessibility in both urban and rural areas, recognizing the disparities in healthcare access across different geographic regions.

3.2.3. Technological Proficiency:

User Tech Comfort: Designing for users with varying levels of technological proficiency, ensuring a user-friendly interface that accommodates a diverse range of technological skills.

3.2.4. Health Awareness and Literacy:

Health Literacy: Addressing the needs of individuals with varying levels of health literacy, providing clear information and educational resources throughout the screening process.

4. External Search

4.1. How Companies Make Money:

- A business model defines how a company generates profits through products/services, target customers, and expenses, serving as the core profitability strategy.
- Common business models include retailers, manufacturers, fee-for-service providers, franchises, marketplaces, and subscription services.
- Evaluation factors include product/service alignment with customer needs, pricing, revenue streams, marketing, and competition.
- Building a robust business model involves steps like identifying customers, selecting products/services, determining sales channels, and ensuring sustainable profitability.
- Successful models meet customer needs at a competitive price while maintaining sustainable costs, requiring periodic reviews to adapt to changes.
- For investors, understanding a company's business model is crucial for interpreting financials. Gross profit, cash flow, and net income reflect the model's effectiveness in generating real profits.

4.2. Breast diseases – HeathDirect

- The page covers diverse breast diseases, encompassing infections, cysts, and both benign and malignant growths. Noteworthy conditions include painful breasts, mastitis, and cancer.
- Women are encouraged to stay vigilant about changes in the look and feel of their breasts and to consult a doctor if any alterations are noticed.
- The page highlights the BreastScreen program, suggesting that women aged 50-

74 receive free mammogram screenings every two years.

- In case of suspicious findings, additional tests such as ultrasound and biopsy are typically conducted to identify the cause.
- While breast diseases are more common in women, the paper acknowledges that men can also be affected, though less frequently.
- Trusted sources like Cancer Australia, Cancer Council, BreastScreen NSW, and Jean Hailes are referenced for more information on specific topics such as breast cancer, common breast conditions, mammogram eligibility, and mastitis.

4.3. Key Statistics for Breast Cancer

- ACS conducts several research studies including CPS-3 which is the Cancer Prevention Study-3. They also have various research teams focused on areas like early cancer detection, extramural discovery science, population science etc.
- They provide information on screening guidelines, cancer facts and statistics from their Cancer Statistics Center.
- They offer training programs through their Center for Diversity in Cancer Research (DICR) which includes internships.
- ACS has different research tools available like the Cancer Atlas, glossary for non-scientists etc.
- Conferences and events like the Jiler Conference and research podcasts are held to discuss research.
- Individuals can apply for ACS grants and view currently funded grants
- They work on encouraging prevention, providing support, addressing disparities, fostering innovation related to cancer.
- Different programs and services are available for patients including navigators, lodging assistance, rides to treatment, support groups etc.
- Individuals can volunteer, fundraise, donate or get involved in various other ways to support ACS' mission.

4.4. Breast Cancer – World Health Organization

- Breast cancer is a disease where abnormal breast cells grow out of control and form tumors, which can spread and become fatal if left untreated. It begins in the milk ducts or lobules of the breast.
- In 2020, there were over 2 million new cases of breast cancer diagnosed globally and over 685,000 deaths. It is the most common cancer worldwide.
- Risk factors for breast cancer include female sex, increasing age, obesity, alcohol use, family history, history of radiation exposure, reproductive history, tobacco use, and postmenopausal hormone therapy. About half of cases occur in women without identifiable risk factors other than age and sex.
- Symptoms can include a breast lump, changes in breast shape or skin, nipple abnormalities, or discharge. Early diagnosis is important for successful treatment.
- Treatment involves surgery to remove tumors, radiation therapy, and medications like chemotherapy, hormone therapy, targeted therapies. The approach depends on cancer subtype and stage. Combined treatments help prevent recurrence.
- The goal of organizations like WHO is to improve early detection, diagnosis and comprehensive management of breast cancer globally to reduce mortality rates

over time through public education, health system strengthening and reliable referral pathways.

4.5. World Wide Cancer Data

- There were an estimated 18.1 million new cancer cases globally in 2020.
- The most common cancers were breast cancer (2.26 million cases), lung cancer (2.2 million cases), and colorectal cancer (1.93 million cases). These three cancers contributed around 12-13% of new cancer cases each.
- In men, the most common cancers were lung cancer (770,828 new cases), prostate cancer (1.41 million cases), and colorectal cancer (865,630 new cases). These top three cancers contributed around 41.9% of new cancer cases in men.
- In women, the most common cancer was breast cancer (2.26 million new cases), contributing 25.8% of new cases in women. The next most common were colorectal cancer (1.06 million cases) and lung cancer (604,127 cases). The top three cancers in women contributed around 44.5% of new cases.
- Cervical cancer was the fourth most common cancer in women globally in 2020, with 604,127 new cases or 6.9% of the total cases in women.

4.6. Breast Cancer in Men

- Breast cancer is rare in men but men can get breast cancer. About 1% of breast cancers diagnosed in the US occur in men.
- The most common types of breast cancer in men are invasive ductal carcinoma and ductal carcinoma in situ (DCIS).
- Common symptoms of breast cancer in men include a lump or swelling in the breast, redness or flaky skin, irritation or dimpling of the breast skin, nipple discharge, or pulling in of the nipple area.
- Risk factors for breast cancer in men include getting older, certain genetic mutations like BRCA1 and BRCA2, a family history of breast cancer, previous radiation therapy to the chest, past hormone therapy treatment for prostate cancer, Klinefelter syndrome, conditions affecting the testicles, liver disease, and being overweight or obese.
- Treatment for breast cancer in men can include surgery, chemotherapy, radiation therapy, hormone therapy, and targeted therapy, depending on the size and spread of the tumor.
- Sharing family history with a doctor can help determine genetic risk and the need for genetic counselling and testing. Genetic mutations can affect screening recommendations.
- Stories from male breast cancer survivors show how finding strength through connection with others can help with the emotional toll of a diagnosis.

4.7. Breast Cancer India

- Journey of breast cancer - Provides details on symptoms, tests, surgery, chemotherapy, radiation therapy and targeted therapy. It includes notes from an oncologist for each

section.

- Indian statistics - Details statistics on breast cancer cases and deaths in India from 2018, also comparing figures for different cities and globally.
- Early detection - Guidelines on remaining alert and detecting breast cancer early for better survival rates.
- Familial breast cancer - Around 6-8% of breast cancers are hereditary and can be passed from mother to children. Details on genetics clinic.

5. Bench marking alternate products

5.1. Existing System: Ubie Symptom Tracker:

Ubie Symptom Tracker is a notable platform for breast cancer symptom tracking, allowing users to input symptoms and receive information about potential indicators. However, a significant limitation exists—the system lacks recommendations for suitable healthcare providers or hospitals.

5.2. Proposed System: Integration of Machine Learning (ML)

Our proposed breast cancer home screening technology addresses this limitation by not only enhancing the accuracy and efficiency of the symptom checker through ML algorithms but also by providing personalized recommendations for healthcare providers. The integration of ML algorithms ensures a more comprehensive user experience, guiding users to suitable professionals and facilities.

5.3. Comparison with Other Websites:

While several informative websites, such as Breastcancer.org, Cancer Research UK, Mayo Clinic, and NHS, provide valuable information about breast cancer symptoms, they primarily function as informational resources and lack dedicated symptom checkers with personalized recommendations.

6. Applicable Regulations

6.1. Data Protection and Privacy:

Personal Data Protection Bill (PDPB): India is in the process of finalizing the PDPB, which aims to regulate the processing of personal data. It is crucial to stay updated on the provisions and requirements of this bill.

6.2. Medical Device Regulations:

Central Drugs Standard Control Organization (CDSCO): Involving medical devices or diagnostic tools, you may need to comply with the regulations set by CDSCO.

6.3. Telemedicine Regulations:

Telemedicine Practice Guidelines: The Ministry of Health and Family Welfare in India has issued guidelines for the practice of telemedicine.

6.4. Information Technology Act:

Information Technology (Reasonable Security Practices and Procedures and Sensitive Personal Data or Information) Rules, 2011: These rules under the Information

Technology Act, 2000, provide guidelines for the collection and storage of sensitive personal data.

7. Constraints

7.1. Budget:

Our project operates on a lean budget, prioritizing cost-effectiveness. We focus on careful allocation of financial resources, with a primary emphasis on minimizing server expenses crucial for data processing and storage.

7.2. Time:

Efficient time management is crucial. We set clear timelines for development, testing, and deployment while evaluating trade-offs between speed of delivery and project scope.

7.3. Space:

Our project embraces a flexible work-from-home model, leveraging collaborative tools for seamless coordination among team members.

7.4. Technology:

The project utilizes Django and Python for web development, emphasizing efficiency and versatility. Machine learning (ML) and deep learning (DL) technologies are seamlessly integrated for accurate data analysis and prediction.

7.5. Skills:

Our team prioritizes strong ML expertise, ensuring effective implementation and optimization of machine learning algorithms. Continuous learning is encouraged to stay abreast of advancements in the ML field.

7.6. Market:

Our target market includes hospitals and healthcare institutions. We tailor project features to meet specific needs identified through market research.

7.7. Security:

Data security is paramount. We implement robust protocols to protect patient data, adhering to industry standards and best practices in healthcare security.

8. Business Model

8.1. Subscription-based Services:

Introduce a subscription model where users pay a recurring fee for premium features, such as advanced symptom analysis, personalized health recommendations, and exclusive content.

8.2. Hospital Partnerships:

Forge strategic partnerships with hospitals for a referral-based revenue model. When

users are recommended to specific hospitals through our platform, we earn a commission for facilitating appointments.

8.3. Data Analytics Insights:

Aggregate and anonymize user data to provide valuable insights to healthcare researchers, institutions, and pharmaceutical companies. This monetization avenue involves selling anonymized data for research purposes.

8.4. Premium Reports:

Offer in-depth, premium health reports with detailed insights and personalized recommendations. Users can purchase these reports for a one-time fee, providing them with a comprehensive overview of their health status.

8.5. Advertising and Sponsorships:

Integrate non-intrusive advertisements within the platform and explore sponsorship opportunities with healthcare-related brands. This revenue stream is based on advertising fees and sponsor partnerships.

8.6. Telehealth Consultations:

Integrate telehealth services where users can opt for virtual consultations with healthcare professionals. Generate revenue through a percentage-based model on each virtual consultation facilitated through our platform.

8.7. Chat BOT integration:

The breast health management chatbot utilizes AI to offer personalized guidance on preventive care, risk assessment, and early detection of breast health issues. It provides access to expert advice, educational resources, and reminders for screenings, empowering users to take proactive steps towards better breast health.

8.8. Educational Webinars and Workshops:

Host educational webinars and workshops on breast health and cancer prevention. Monetize these events through ticket sales or sponsorships.

9. Concept Generation

9.1. Problem Identification:

Understand the challenge of early breast cancer identification, considering limitations in the current healthcare system and diagnostic tools.

9.2. User Research:

Conduct extensive research to understand the needs, concerns, and behaviors of potential users, including insights from individuals, healthcare professionals, and institutions involved in breast cancer care.

9.3. Technology Assessment:

Explore the latest technologies in machine learning, deep learning, and medical imaging

to leverage them for accurate breast cancer identification.

9.4. Collaboration with Healthcare Professionals:

Engage with healthcare professionals, including oncologists, radiologists, and breast cancer specialists, to understand their workflow, challenges, and potential gaps that technology can address.

9.5. Ideation Workshops:

Conduct ideation workshops with a cross-functional team to encourage brainstorming and generate a wide range of ideas.

9.6. User Stories and Personas:

Create user stories and personas based on research insights to envision how users would interact with the solution and identify valuable features.

9.7. Feature Prioritization:

Prioritize features based on user needs, technological feasibility, and potential impact on breast cancer identification, focusing on core features for early detection.

9.8. Iterative Prototyping:

Build iterative prototypes and test them with potential users to gather feedback on usability, effectiveness, and user satisfaction. Refine and enhance the concept based on feedback.

9.9. Validation with Healthcare Professionals:

Validate the concept with healthcare professionals to ensure alignment with medical standards and gather input on how the technology can complement existing diagnostic methods.

9.10. Ethical Considerations:

Address ethical implications, especially regarding data privacy and responsible technology use in healthcare, adhering to relevant ethical guidelines and regulations.

9.11. Market Analysis:

Analyze the market landscape, identifying competitors and gaps. Highlight how the proposed concept stands out and addresses unmet needs.

9.12. Feasibility Study:

Conduct a feasibility study considering technical, financial, and operational aspects to ensure realistic implementation within given constraints.

10. Concept Development

10.1. Key Features:

10.1.1. Symptom Checker:

An intuitive tool for users to input symptoms, providing initial assessments of breast cancer likelihood and links for how to personally check for each symptom, if applicable.

10.1.2. Machine Learning Algorithm:

Inclusion of a robust machine learning algorithm for precise symptom analysis, enhancing diagnostic accuracy.

10.1.3. Telehealth Integration:

Seamless integration of telehealth services for virtual consultations, ensuring comprehensive evaluation and guidance.

10.1.4. User-Friendly Interface:

A user-centric design emphasizing simplicity and accessibility, catering to varying technological proficiencies.

10.1.5. Secure Data Handling:

Implementation of robust security measures ensuring confidentiality and privacy, adhering to stringent healthcare data protection standards.

10.1.6. Hospital Recommendations:

Streamlined hospital recommendations based on symptom analysis, creating a direct pathway for users to seek professional medical attention.

10.1.7. Subscription Services:

Introduction of premium services through subscriptions, offering enhanced features such as detailed health reports, personalized wellness plans, and priority access to telehealth consultations.

10.2. Validation Approach:

10.2.1. User Testing:

Iterative user testing throughout development to gather feedback on usability, effectiveness, and user satisfaction.

10.2.3. Healthcare Professional Input:

Collaboration with healthcare professionals for validation of the diagnostic algorithm and alignment with medical standards.

10.2.4. Ethical Review:

Thorough ethical review ensuring responsible data handling and compliance with healthcare ethics and regulations.

10.3. Market Positioning:

The Breast Cancer Identification Platform positions itself as a user-centric, technologically advanced solution, emphasizing early detection, education, and user

empowerment. Notably, after sending data from our site, hospitals can utilize mammograms for cancer detection, integrating ML models developed by us to ensure more accurate and efficient results. This innovative approach reinforces the platform's commitment to advancing breast cancer awareness and prevention.

11. Final Prototype

11.1. User Input:

Users input their symptoms through the platform.

11.2. Symptom Checker:

The platform employs a robust machine learning algorithm to analyze symptoms.

11.3. Telehealth Integration:

Integrated telehealth services enable virtual consultations with healthcare professionals.

11.4. User-Friendly Interface:

A user-friendly interface ensures ease of interaction for users with varying technological proficiency.

11.5. Secure Data Handling:

Stringent security measures are in place to protect user data and ensure confidentiality.

11.6. Hospital Recommendations:

Based on symptom analysis, the platform provides recommendations for suitable hospitals.

11.7. Subscription Services:

Optional subscription services offer enhanced features for users.

11.8. Appointment Booking:

Subscribed users can conveniently book appointments directly through the platform.

11.9. ML Models for Hospitals:

Hospitals can leverage ML models developed by the platform for more accurate cancer detection, based on mammograms.

11.10. Validation Approach:

Iterative user testing, collaboration with healthcare professionals, and adherence to ethical standards ensure the platform's effectiveness and alignment with medical standards.

11.12. Market Positioning:

The platform positions itself as a user-centric, technologically advanced solution, focusing on early detection, user empowerment, and collaboration with healthcare

professionals.

11.13. End:

Conclusion of the user journey.

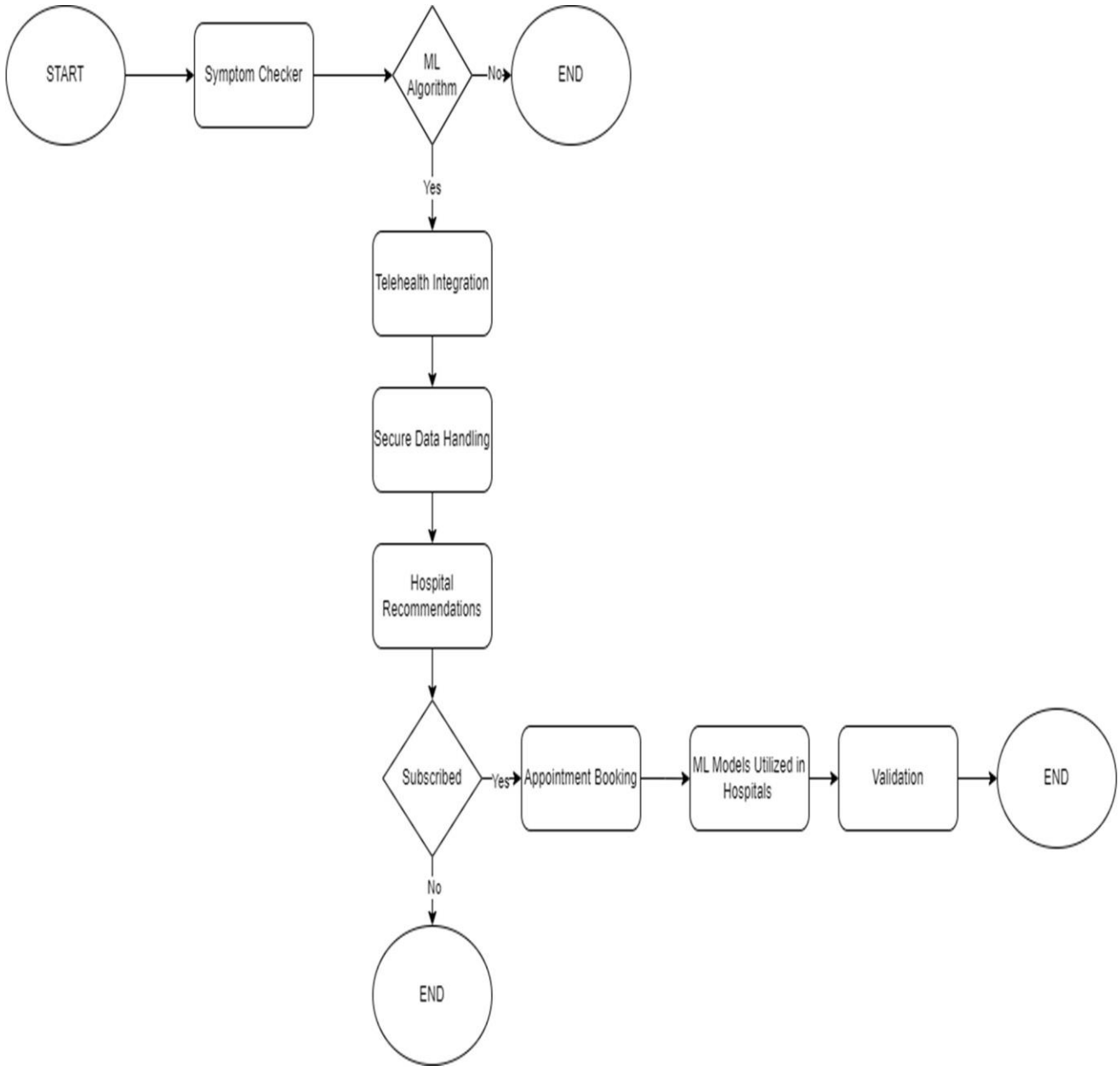

Fig 4. Schematic Diagram

12. Conclusion

In conclusion, the Breast Cancer Identification Platform stands as a pioneering solution, poised to make a significant impact on early breast cancer detection and user empowerment. By seamlessly integrating advanced technologies such as machine learning, telehealth services, and a user-friendly interface, the platform addresses critical challenges in the current healthcare system.

The emphasis on secure data handling reflects our commitment to not only identifying breast cancer early but also ensuring the privacy and confidentiality of user data. The incorporation of a robust machine learning algorithm ensures precise symptom analysis, enhancing diagnostic accuracy and providing users with reliable assessments.

The collaboration with healthcare professionals, iterative user testing, and adherence to ethical standards underscore our dedication to creating a solution that aligns with medical standards, is user-friendly, and respects privacy.

Furthermore, the innovative feature allowing hospitals to utilize ML models developed by us for cancer detection, based on mammograms, adds an extra layer of accuracy to the diagnostic process. This unique approach positions the platform as a comprehensive and collaborative tool in the fight against breast cancer.

In essence, the Breast Cancer Identification Platform aims not only to detect breast cancer early but also to collaborate with healthcare professionals for a holistic approach to breast health. This endeavour reflects our commitment to advancing breast cancer awareness, prevention, and ultimately contributing to improved healthcare outcomes.

13. Financial Model

13.1 Breast Health Predictive System

Breast_Cancer_Pred.ipynb

- Description: Employs advanced machine learning algorithms to analyze a diverse range of features extracted from breast cancer biopsy samples. These features encompass crucial metrics like mean radius, texture, perimeter, area, smoothness, compactness, concavity, concave points, symmetry, and fractal dimension. The system serves as a pivotal tool in the early detection and risk assessment of breast cancer, offering a non-invasive and efficient means of intervention.

Components:

- Input Data: Comprises biopsy sample features meticulously collected during diagnosis.
- Model: The heart of the system, a meticulously trained machine learning model adept at categorizing tumors as either malignant or benign based on the provided features.
- Prediction: Provides accurate predictions regarding the likelihood of breast cancer, empowering healthcare professionals and patients alike with crucial insights.

13.2 Chatbot

Chatbot Breast Health FAQ

- **Google GenerativeAI API:** Based on the pricing structure and estimated usage, the cost can vary significantly depending on the volume of interactions.
- **Streamlit Hosting:** Self-hosting costs can vary based on server specifications and usage, while cloud-based hosting might start from around ₹500-₹1000 per month depending on the chosen plan.

- **Other costs:** Domain and SSL can be relatively inexpensive (around ₹500-₹1000 per year combined), and additional features might have varying costs depending on implementation.

- **Pricing:**
    - Individual user subscription (FAQ chatbot + basic ML prediction): ₹50/month
    - Hospital subscription (advanced ML prediction + Generative chatbot): ₹1000/month
- **Market Growth:**
    - Individual user segment: Moderate linear growth (10% per year)
    - Hospital segment: Steady exponential growth (20% per year)
- **Fixed Costs:**
    - Platform development: ₹100,000 (one-time cost)
    - Server maintenance: ₹1,500/month
    - API subscriptions (e.g., Dialogflow, Gemini Pro): ₹500/month

13.3 Financial Equation

Estimation for x(t):

- **Individual users:**
    - Year 1: x(1) = 1000 (initial users)
    - Year 2: x(2) = 1000 (1 + 0.1) = 1100
    - Year 3: x(3) = 1100 (1 + 0.1) = 1210
- **Hospitals:**
    - Year 1: x(1) = 10 (initial hospitals)
    - Year 2: x(2) = 10 (1 +0.2) = 12
    - Year 3: x(3) = 12 (1 + 0.2) = 14.4

Calculating Profit:

- **Individual Users:**

  Revenue: 1000 users ₹50/month 12 months = ₹600,000

  Variable costs: (API subscriptions + other per-user costs) 1000 users =₹5001000 users =₹500,000

  Contribution margin: Revenue - Variable costs=₹100,000

- **Hospitals:**

  Revenue: 10 hospitals ₹2000/month 12 months =₹240,000

  Variable costs: (API subscriptions + other per-hospital costs) 10 hospitals =₹1500+₹50010 hospitals= ₹240,000

  Contribution margin: Revenue - Variable costs= ₹0

- **Total Contribution Margin (Year 1):** Contribution margin (Individual Users) + Contribution margin (Hospitals)=₹100,000
- **Total Fixed Costs (Year 1):** ₹100,000 (development) + ₹18,000 (server maintenance) + ₹6,000 (API subscriptions) = ₹124,000
- **Profit (Year 1):** Total Contribution Margin (Year 1) - Total Fixed Costs (Year 1) =₹24,000