Machine Learning-based Mixed Reality Breast Cancer Detection

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ABSTRACT: Breast cancer is one of the most prevalent diseases affecting women, manifesting as an anomaly in breast cell growth. To reduce any issues, a prompt diagnosis is crucial. Early disease identification, including cancer, is made easier with the widespread application of algorithms. As part of our effort to detect breast cancer, we have developed a mechanism that allows us to respond promptly to values derived from a patient's breast cell report. This application quickly ascertains the condition of the cell, indicating whether it is benign or cancerous. The UCI repository's Breast Cancer Madison (Initial) dataset is used in our investigation. We looked into five different classification algorithms—Decision Tree, Random Forest, KNN, Naive Bayes, and Logistic Regression—in order to identify trends.

KEYWORDS: Breast Cancer, CNN Algorithm, Decision Tree, Random Forest, KNN, Mixed Reality Codes, 3D image through Unity Software.

I. INTRODUCTION

Early and accurate diagnosis is essential for effective treatment and management of female breast cancer, a severe worldwide health concern. In this work, we provide a revolutionary approach that radically alters the way breast cancer is diagnosed by combining the most latest MR Codes technology with machine learning techniques. Based on input values from a patient's breast cell report, our system reacts quickly and evaluates whether a breast cell report is normal or malignant. The UCI repository's Breast Cancer Syndrome (First Version) dataset is used for this. We look into five different classification techniques: logistic regression (LR), decision trees, KNN, and Naive Bayes. The decision tree method has the highest accuracy, at 95.90%. By employing multiple attribute extraction techniques, we further strengthen the model's resilien ce, which eventually increases accuracy.

II. LITERATURE SURVEY

According to Darcey E. et al., mammographic tumor density (MBD) is a strong, highly familial predictor of breast cancer risk as well as an indicator of the disease [1]. This study evaluates MBD as a quantitative trait, or endophenotype, associated with a hereditary risk of developing breast cancer. Based on information from the family-based kConFab Study and the 1994/1995 cross-sectional Busselton Health Study, participants were divided into three groups: controls, relatives of cases, and cases. The participants' mammograms were utilized to determine the proportion density and real congested section. The evaluation of each endophenotype specification was done using blended linear models and heritability analysis. Meta-analyses of both studies showed that the MBD measures were higher in relatives compared to controls (β = 0.16, 95% CI = -0.24, 0.56 and β = 0.16, 95% CI = -0.21, 0.53 for DA and PDA, respectively) and in cases compared to relatives (β = 0.48, 95% CI = 0.10, 0.86 and β = 0.41, 95% CI = 0.06, 0.78 for DA and PDA, respectively). This study shows, for the first time, a strong correlation between the MBD characteristic and breast cancer.

According to Beatriz M. DeJesus et al. (2023), In order to investigate the effects of electrical nerve stimulation on analgesia and sensitization tests in studies including both acute experimental pain and chronic musculoskeletal suffering, this study undertakes a thorough assessment of scientific literature. Meta-analyses supported TENS despite its limits and heterogeneity [2]. Of the mentioned study, only two explored temporal summation, thirty-four studied pain intensity, twenty-four studied hyperalgesia, and none showed evidence of modulation of conditioned suffering. In the included study, primary excessive pain in musculoskeletal pain studies showed a high degree of evidence; other outcomes, however, showed intermediate evidence. Experiments with acute pain have confirmed this, as seen by the decrease in primary and secondary hyperalgesia, pain intensity during rest and exercise, and long-term musculoskeletal discomfort. The two study categories that this review looked at frequently provided meta-analyses that backed the use of TENS (as opposed to placebo TENS), showing decreases in both the two forms of hyperalgesia and the amount of pain experienced during rest and motion.

According to K. Whitaker and colleagues, the majority of cancer cases in England are discovered outside of the three main national cancer screening programs. For this reason, you should see your primary care physician as soon as possible if you think you may have cancer (cancers include cancers of the intestines, breast, and cervical regions). The importance of symptomatic presentation is demonstrated by the widespread adoption of initiatives designed to increase public awareness of early cancer indicators [3]. Although Very Honest on Cancer is spearheading these initiatives in England, they are being imitated globally, particularly in middle-class and lower-class nations like India, Malaysia, and South Africa.

Meng, G. and associates demonstrated that neural network-based techniques are the most popular. It is regarded as an area within artificial intelligence. Without being created especially for this use, machine learning algorithms build computer models that use sample data, or "training data," to produce forecasts or predictions [4]. A foundational element of most machine learning techniques is computational statistics. Soft computing facilitates the application of methods designed to generate solutions for practical problems that are difficult to model using conventional methods. The phrase "soft computing" refers to the application of several methodologies, including bio-inspired, swarm intelligence, fuzzy logic, and advanced learning approaches, to tackle challenging real-world problems.

Examining the diagnostic value of contrast-enhanced ultrasonography in clinical settings and its capacity to distinguish between the two types of breast lesions was the goal Y. Zhang, B. et al. proposed. For contrast-enhanced ultrasonography, time-intensity charts (TICs) were obtained, and perfusion parameters were collected and examined. Unequal filling defects and contrast agent retention, irregular form and vasculature phonology 'fast-out' wash-out mode, unclear borders, and uneven internal echo were frequently observed in inflammatory breast tumors. To determine which lesions were benign, the synchronous wash-out or "slow-out" mode was employed.

III. SYSTEM DESIGN AND METHODOLOGIES

Women are more likely than males to be affected by breast cancer, and early detection is key to reducing problems. The abnormal development of breast cells is a characteristic of breast cancer. Most machine learning and neural network techniques are used in the detection of diseases like cancer. In an effort to combat breast carcinoma, a system that accepts data from a patient's breast cell report and instantaneously ascertains the type of carcinoma—benign or malignant—has been developed. Information Source: The study makes use of the Breast Cancer Milwaukee (distinct) dataset from the UCI repository, which is a helpful resource for creating and evaluating machine learning models.

A. Working Principle

The foundation of machine learning algorithms used in breast cancer diagnosis is the process of training, evaluating, and putting into practice a model that can identify patterns suggestive of malignancy in medical pictures. An assortment of medical photos, including mammograms and breastbone ultrasonography scans when needed, labeled with the severity or benignity of each image's anomalies. Clean up and preprocess the dataset to ensure uniformity and quality. This can mean resizing images, modifying pixel values, and resolving any anomalies or inconsistencies in the data. Choose between applying a logical model design or a prediction algorithm. Because deep learning models, like CNNs, can automatically build ordered representations from visual data, they have shown substantial success in detecting the presence of breast cancer. Train the selected model using the labeled training dataset.

The model communicates with the Arduino motherboard and ESP8266 micro controller to enable efficient and safe data transfer. Utilizing the World Wide Web of Things' features enhances accessibility and expedites processing, allowing for prompt diagnosis and repair. Diagnoses are wrapped in MR codes to allow safe transmission across IoT infrastructure. These programs coordinate a three-dimensional model with Unity software, serving as conduits for the data display associated with breast cells. This dynamic 3D environment brings the diagnostic discoveries to life.

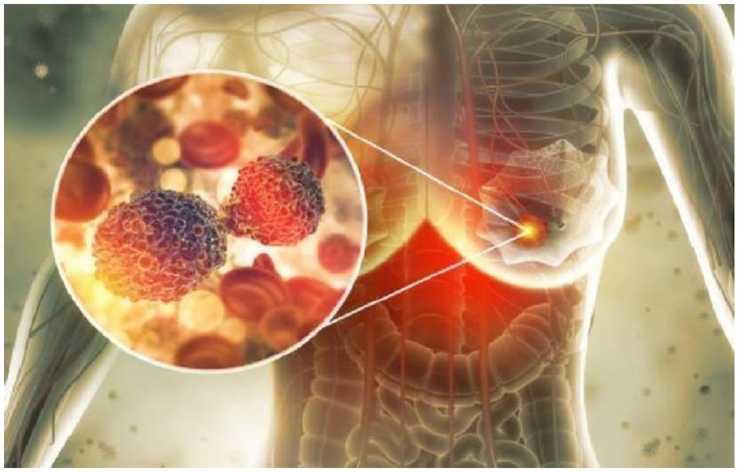

Fig1: Formation of cancer cells in breast

An LT vision camera can be used to scan the MR Codes, as shown in Fig. 1. These apps can be used with Unity software to create a three-dimensional representation that provides a comprehensive overview of the affected dataset. The three-dimensional image's vivid red coloring of the affected cells provides an appropriate visual representation for the seriousness of the issue. This unique approach improves comprehension and interpretation of the data collected, allowing medical professionals to make decisions based on a more intuitive understanding of the information. Our system presents an innovative approach to integrate MR Codes with 3D visualization in medical data processing, which has the potential to transform the identification of breast carcinoma. It also provides a quick and precise assessment of malignancy.

Most tumors that start in the mammary gland are referred to be breast cancers. A rising proportion of women are already afflicted by this fatal sickness, and the daily death toll from it rises. The only method to control it is to find it as soon as possible and use excellent analysis and therapy based only on the phase of the majority of cancers; this may also help people gradually lessen their chances of dying.

A classification mannequin that can predict the majority of breast tumors based on their attributes can be created using machine learning techniques, such as Deep Learning algorithms that employ convolution neural networks. The following are a few signs and symptoms of breast cancer that are used to categorize the disease into stages: a thickening or bulging of the breastbone that feels different from the surrounding tissues. Modification of a breast's dimensions, form, or appearance. A alteration in the mammary glands pore spaces and skin is called dimpling. The pigmented pore area of the skin around the breast skin or nipple (areola) has lately turned, peeling, scaling, crusting, or flaking. Your breasts' skin and pores could be red or pitted, similar to an orange's pores.

B. Proposed Block Diagram

This model offers an extensive analysis of breast cancer based on magnetic resonance imaging through the use of the Internet of Things (IoT innovation). The people who have breast cancer will be greatly impacted by the findings of this study. The block diagram for the proposed system is shown in Fig2.

After the hardware was put together, the software was added. An Arduino Uno board, a 16x2 LCD, an ESP8266 microprocessor, and other parts are interfaced with and connected to the application. This chapter discusses how to install the suggested system and its results.

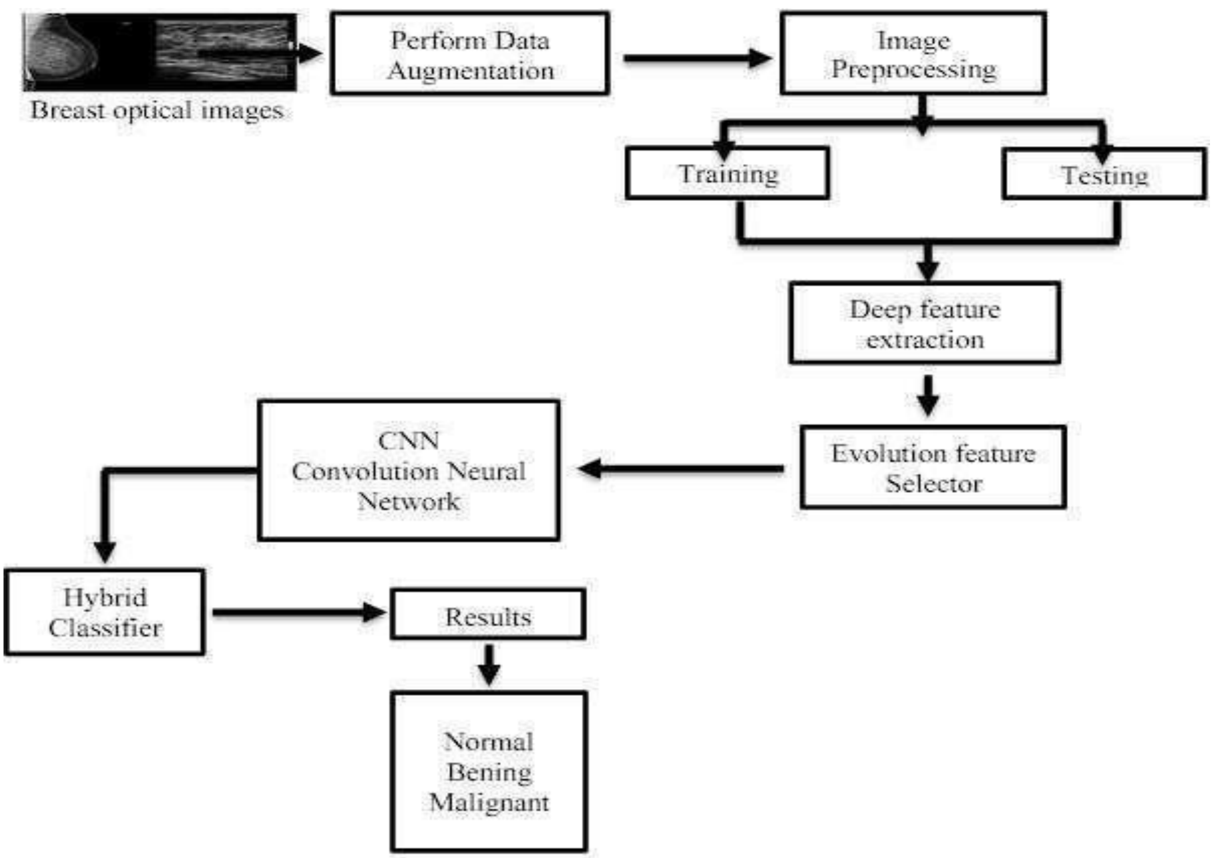

Fig 2 . Block Diagram of the Proposed System

IV. EXPERIMENTAL RESULTS

This section explains the experimental setup and methodology used for prototype, which was a trial-and-error configuration derived from earlier versions and shown in Fig 3. . Prostate cancer, which is also on the rise, is the most frequent malignancy in the African country. A sizable fraction of female cancer patients reside in remote locations. There may be too much information available, since many women miss out on early detection because they don't know about and don't employ BSE and other screening techniques. According to the study, there is a tendency for patients who appear with late-stage symptoms to misdiagnose their painful, swollen, red breasts as an inflammatory illness.

Hardware Implementation:

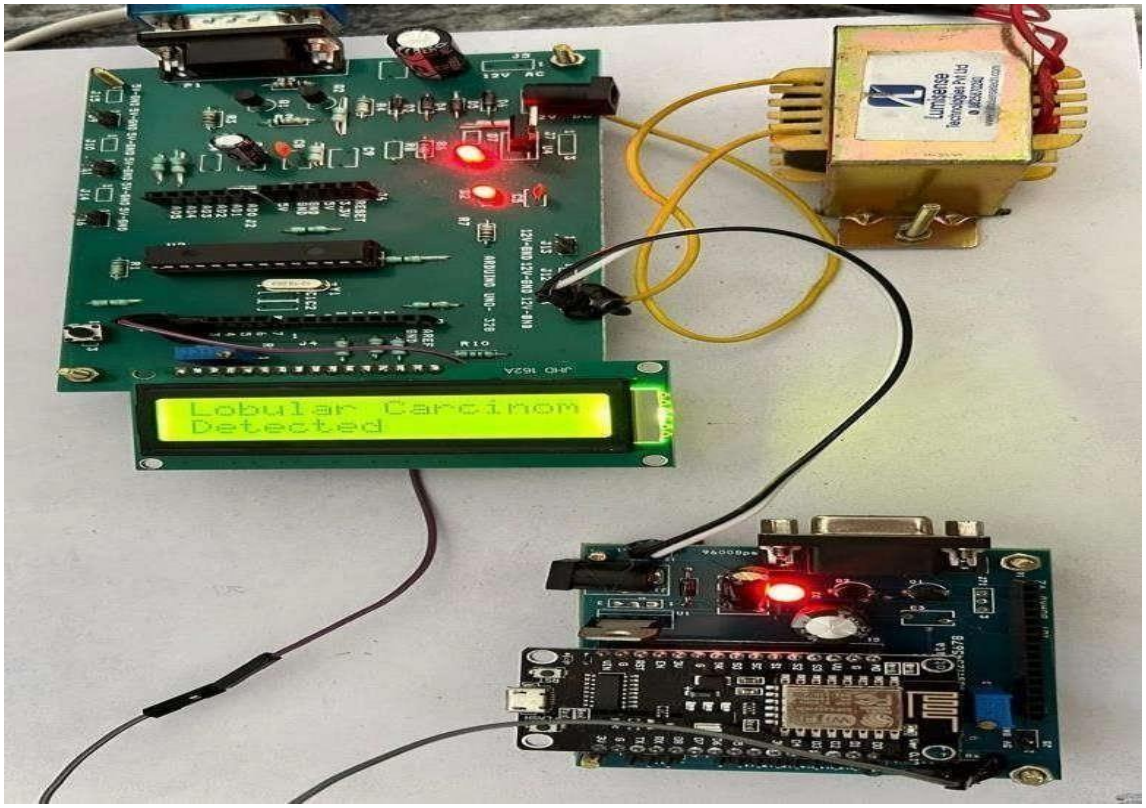

Fig 3: Prototype Implementation

The results of the breast cancer monitoring project offer crucial new insights into the classification of various stages of breast tissue. Since common conditions don't involve anomalies, they are appropriately categorized as ductal. The segments are arranged into nip segments via ducts in a manner consistent with the normal organization of breast tissue. Papillary conditions are a good way to characterize benign circumstances that point to anomalies or noncancerous growths. This classification denotes the presence of benign tumors or growths within the breast tissue, often distinguished by projections resembling fingers. On the other hand, malignant diseases belong in the lobular category since they are tumors or growths that are carcinogenic. This classification implies the presence of carcinogenic cells in the breast lobules, the organs that produce milk.

Experimental Procedure

The display highlights malignant cells with vibrant red hues, giving clinicians' clear and helpful information. Strict protocols for assessment and confirmation To make sure the system is dependable and effective in practical settings, confirm its functioning and diagnostic accuracy. The result of this recurrent process is a period of comprehensive reporting and documentation that makes the project's objectives, methods, and conclusions clear. In the pursuit of early detection and better patient outcomes, this comprehensive approach to cancer detection offers hope for transforming diagnostic paradigms. The divided work flow of the main inputs for web-based accommodation is depicted in Fig. 4. Essentially, the application is in charge of managing all the data, and the only way to access it is to prove who you are using a user ID and password. Every person has a specific access domain that they are not allowed to enter or are dynamically opposed from entering. The main outputs of the system are tables and reports. Tables are dynamically produced in response to needs as they emerge. Naturally, reports hold the majority of the information that is disseminated throughout the company. It is necessary for this software to be able to generate output at various modules for various inputs.

As a partial completion of my academic ambitions, the book was written with the academic frameworks of my bachelor's and master's degrees from the university in mind. The document contains the general procedure that I followed when researching and developing the system. The industry provided a basic document to help me understand my roles in building the system and the requirements that have been precisely stated to obtain the system's exact structure as specified by the actual client. My project manager claims that the system used a series of surveys and interviews to ascertain the intended actual criteria of the specification. The specification document was created by organizing the collected data, and it was then modeled to precisely match the needs of the system.

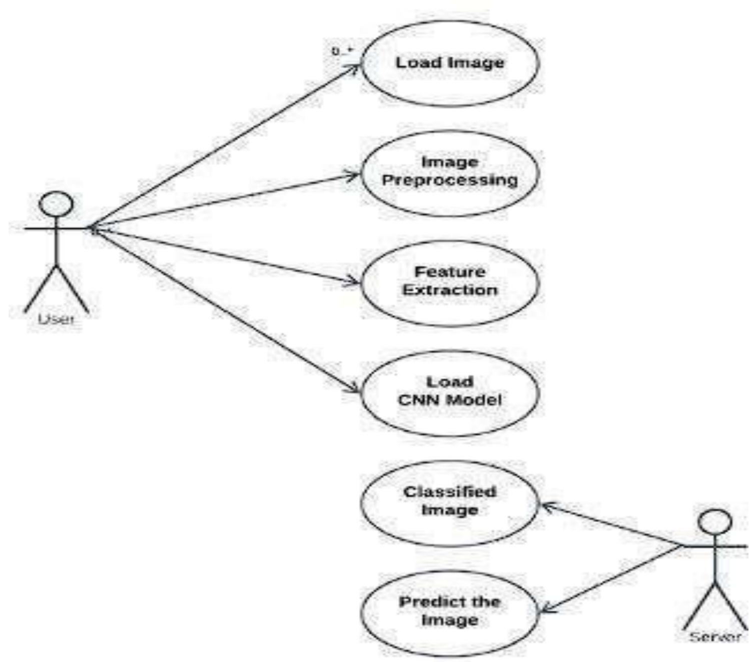

Fig.4.Work Flow of the algorithm

This initiative is at the forefront of healthcare innovation and has the potential to significantly improve the lives of patients impacted by breast cancer by utilizing the synergies of IoT, MR, and machine learning. Using Unity software, a 3D picture is displayed, with cancerous cells indicated in red. Extensive testing and validation are used to verify the accuracy of the diagnostics and system performance. The workflow is finished with comprehensive reporting and documentation that addresses the project's objectives, methods, and conclusions. With this multimodal approach to early breast cancer identification, it is possible to save lives, enhance patient outcomes, and transform diagnostic procedures.

Results and Discussions

As mentioned earlier, the training phases collected and archived information that served as a representation of the findings from the investigation into the detection of breast cancer and provided insightful new information regarding the categorization of illnesses impacting the breast tissue. Since common circumstances don't involve any anomalies, they are appropriately categorized as ductal. This division is consistent with the normal structure of breast tissue, in which ducts transport milk from the axilla to the nape. The exact definition of papillary issues is benign diseases suggestive of abnormalities or noncancerous growths. This classification denotes the presence of benign tumors or growths within the breast tissue, often distinguished by projections resembling fingers. In addition, malignant illnesses are appropriately classified since they are malignant growths or tumors.

According to this classification, there are cells in the mammary lobules, which produce milk that have the potential to develop into cancers. Overall, the data analysis shows how effectively the categorization method distinguishes between benign, malignant, and normal breast tissue situations, providing medical practitioners with valuable diagnostic information and facilitating timely patient treatments.

The women's breast cancer monitoring effort uses cutting edge technology including IoT, MR, and machine learning to revolutionize diagnosis processes. Following meticulous pretreatment of the data and testing of several algorithms, the tree-based method proved to be the most accurate, achieving an amazing 95.90% classification accuracy.

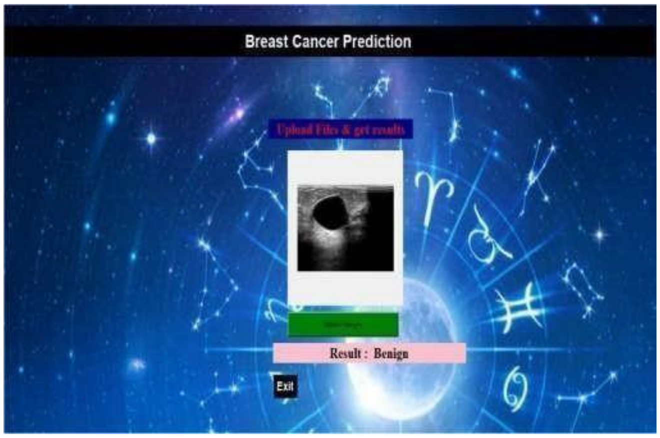

Fig.5. Identification of benign tumour cells

A major turning point in the project's progress was reached when the IoT components were combined, as shown in Fig. 4. This allowed for continuous data transfer and analysis, as shown in Fig. 5. The Arduino and ESP8266 microcontroller on the Uno board enabled smooth connectivity, which in turn enabled the system to accept data, process it quickly, and give timely diagnostic feedback. This section emphasizes the revolutionary potential of IoT technologies in the healthcare sector, since early intervention can greatly enhance patient outcomes in medical settings. Furthermore, the utilization of MR visualization methods enabled by Unity software produced intelligible three-dimensional depictions of diagnostic outcomes. Through immersive visualization, clinicians may effectively assess and understand diagnostic results, facilitating informed decision-making and customized treatment regimens.

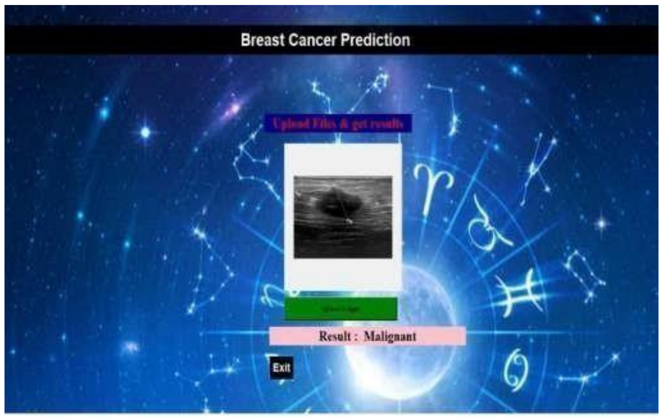

Fig.5. Identification of malignant tumour cells

Fig. 5 illustrates how the integration of these technical developments offers a comprehensive strategy to enhance patient outcomes, leading to a revolution in the identification of breast cancer. The inquiry has shown promising potential to change diagnostic procedures and open the door for more precise, effective, and customized approaches to breast cancer diagnosis and treatment by utilizing the synergies of machine learning, IoT, and MR technologies. More research and development efforts in the ongoing battle against breast cancer may result in improved patient outcomes and more sophisticated diagnostic instruments.

The results showed that lobular anomalies, which represent cancerous growths or tumors, are accurately characterized as malignant states.

V. CONCLUSION

Conclusively, the program for detecting breast tumors marks a noteworthy advancement in the field of medical diagnosis by utilizing state-of-the-art technology to enhance precision, effectiveness, and patient results. The system that was developed showed exceptional accuracy in classifying data thanks to meticulous feature extraction, algorithm selection, and data preparation. The decision forest method was shown to be the most successful classifier. The smooth integration of IoT components enabled for real-time data processing and distribution, enabling the timely diagnosis and action required to enhance the lives of patients.

Moreover, the utilization of magnetic resonance imaging (MR) visualization techniques yielded unique three-dimensional representations of diagnostic outcomes, furnishing healthcare practitioners with essential perspectives on the attributes and spatial connections of cancers. This comprehensive method of detecting breast cancer highlights the potential for revolutionary results in healthcare through interdisciplinary collaboration and technological innovation. By combining the capabilities of IoT, MR, and Machine Learning; we can transform breast cancer diagnosis and therapy. In the end, this might lead to interventions that save lives and an improvement in the standard of care given to patients everywhere.

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