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CONTENTS

The development potential of ecotourism and sustainable tourism practices in the kashkadarya region.....	6
Khushvakhtov Ramziddin	
How transport access affects housing prices.....	9
Mannonov Shahzod Istam Ugli, Ibragimov Xasan Usmonjon Ugli	
Prospects and effectiveness of implementing mobile marketing technologies in higher education institutions.....	18
Murod Batirovich Khidoyatov	
Factors influencing the development of the food processing industry: an economic analysis.....	23
Urolova Sevara Bekhzod kizi	
Ensuring cybersecurity in commercial banks of Uzbekistan.....	29
Erdashov Alimjan Baxramovich	
University students' adoption of cashless payments in uzbekistan: behavior, trust, and challenges.....	33
Khikmatullaev Ismoilkhuja Khusan ugli, Asep Miftahuddin	
The effects of inflation rate and investment rate toward unemployment in Uzbekistan.....	43
Ruziev Bekmurod Urol ugli, Dr.Susanti Kurniawati	
The importance of using e-commerce systems in enhancing the financial potential of joint-stock companies.....	47
Vakhobov Shokhjahan Valiyevich	
Integration of optoinformatic systems and artificial intelligence for automatic quality control of video equipment.....	50
Allamuratov Timur Koshmurat uli	
The role and importance of commercial banks in the development of the capital market.....	53
Aybek Kayipbergenov, Baymuratova Zina Akilbekovna	
Global trends in mobile payment adoption: a systematic literature review with insights for indonesia.....	57
Mukhitdinov Islomjon Jakhongir ugli, Dr. Maya Sari, S.E., M.M.	
Decision-making algorithms in higher education management: application of artificial intelligence systems in indonesia.....	65
Sattikulov Mukhammadkhon, Budhi Pamungkas Gautama	
Innovation financing mechanisms for enterprises in uzbekistan: current state, systematic analysis, and strategic development directions.....	72
Sukhrob Turanov	
The role of the islamic financial system in financing infrastructure projects.....	81
Mamadiyarova Aziza Nuriddin kizi, Dr. Denny Andriana	
Statistical analysis of total population income in the republic of Uzbekistan.....	85
Akbarova Barno Shuxratovna, Chintemirova Diyora Shuxrat kizi	
Strengthening the financial resource base of commercial banks in the context of digitalization.....	89
Dilnoza Khaitboyeva	
Using examples of folklore to effectively organize the process of teaching english to children through digital learning tools.....	94
Boqijonova Nargiza Jumanazar kizi, Rajabboyeva Gulchexra Foziljon kizi	
Standard methodology of throwing techniques in judo and their effectiveness.....	97
Tangriyev Abdulkarim Tivoshevich	
Improving marketing management at the enterprise.....	101
Musayeva Shoira Azimovna	
The financial-theoretical frameworks of the anti-monopoly regulation in the digital economy.....	106
Djalilova Dilnoza Raxmatovna	

Modern approaches to deposit turnover and operations in commercial banks	110
Olimov Abror Axadjon o'g'li	
The Role of Innovation Policy in Advancing Uzbekistan's Textile Industry: Empirical Evidence and Strategic Forecasting.....	115
Ravshan I. Nurimbetov, Khojakbar M. Karimov	
Aformalized model of backward throwing technique: a methodological approach for judo	121
Tangriyev Abdullo Tovoshevich	
The Role of External Audits in Strengthening Corporate Governance: A Case Study of Aloqabank	126
Rustamov Muhammadyusuf Madaminjon ugli, Indah Fitriani, SE., Dr. Aristanti Widyaningsih, S.Pd.,	
Comparison of mental disorders in parents of children with developmental defects with mental disorders in parents of healthy children without defects	132
Yadgarova Nargiza Fahriddinova, Mirzaliyeva Surmaniso Alisher kizi	
Inflation and the Financing of Education in Uzbekistan: A Mediation Analysis of Macroeconomic and Social Channels.....	138
Toshpulatov Jakhongir Dilmurod ugli, Dr Arief Ramdhany	
Quantitative Analysis of Financial Statement Fraud in Uzbek Banks: Patterns, Red Flags, and Risk Indicators	145
Ismatullaev Javokhir Jahongir ugli, Toni Heryana, Elis Mediawati	
Dynamics and analysis of value added tax revenues in the state budget of uzbekistan	152
Ergashev Ilkhomjon Obodovich	
The role of green bonds in the stock market as a sustainable financial instrument.....	157
Khushvakov Islombek Mukhammadi ogli	
Uzbekistan's transition to a cashless society: policy reforms and comparative analysis.....	162
Khikmatullaev Ismoilkhuja Khusan ugli, Dr. Maya Sari, S.E., M.M.	
Strategic approaches to innovation process management.....	170
Togonov Ibrohimkhoja	
Exploring renewable hydrogen pricing strategies: addressing cost uncertainties	174
Komila Sanakulovna Nuraliyeva	
Diversification of Major International Transport Corridors in the Interests of Uzbekistan	179
Mukhlisakhon Ulug'bek qizi Qo'chqorova	
Using digital technologies in libraries: advantages and problems.....	184
Ernaqulov Sunnatillo Nurali o'g'li	
Econometric analysis of external labor migration	189
Akbarova Malika Ilkhomovna, Gulmurodov Kamoliddin Abdukodir ugli	
Developing more effective and financial tools to stimulate tourism in the republic of Karakalpakstan.....	194
Tleumuratov Baxadir Genjemuratovich	
Ways to improve the effectiveness of social networks in the development of tourism.....	200
Kasimova Zilola Gulamiddinova	
The system of developing students' learning initiative through education based on a national cultural approach.....	205
Azimova Nilufar Nuriddinova	
Development of the classification algorithm and experimental verification.....	211
Otakhonova Saodat Otabekovna	

DEVELOPMENT OF THE CLASSIFICATION ALGORITHM AND EXPERIMENTAL VERIFICATION



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Abstract: This article describes the development of the “Disease detection algorithm via medical images” program, aimed at early diagnosis of breast cancer using mammographic images. Breast cancer is one of the most common oncological diseases among women, and early detection of tumors significantly affects patient survival rates. The paper proposes the use of Python and libraries such as Tkinter, OpenCV, Pillow, and NumPy to create an effective diagnostic system. An important part of the work is the description of the breast structure and the role of different tissue types in tumor diagnosis. Additionally, image processing methods such as edge detection, filtering, and texture analysis are discussed, which are applied to enhance diagnostic accuracy.

Key words: Classification, breast cancer, mammography, diagnostics, Tkinter, amulet, medical images.

INTRODUCTION

In recent years, various medical imaging methods — including computed tomography (CT), magnetic resonance imaging (MRI), positron-emission tomography (PET), mammography, ultrasound, and radiography — have been widely used for early disease detection, diagnosis, and treatment. One such application is the “Medical Image-Based Disease Detection Algorithm”, which is used for early-stage breast cancer detection through mammographic images.

Currently, breast cancer ranks among the most common malignant diseases in women. It is frequently observed in women over the age of 50 and is associated with several risk factors, including genetic predisposition, alcohol consumption, nulliparity (never having had children), giving birth after the age of 30, not breastfeeding, long-term use (more than one year) of medications containing estrogen hormones, and prior exposure to radiation. However, in recent years, an increasing number of younger women have also been diagnosed with this disease [1].

LITERATURE REVIEW AND METHODOLOGY

A number of significant studies have been conducted in the field of medical image diagnosis using automated image analysis systems. For instance, Cireşan et al. (2013) employed a deep learning method to automatically detect breast cancer based on mammographic images. The utilization of neural networks has notably increased the accuracy of tumor detection and improved the diagnostic process overall.

Machine learning and deep learning play a critical role in medical image analysis. LeCun et al. (2015) investigated the application of neural networks for image classification and analysis [2]. Deep learning algorithms have proven effective in performing tasks such as image labeling, classification, and prediction, making them indispensable tools in modern medical diagnostics.

Among imaging methods, mammography remains one of the most effective tools for early detection of breast cancer. Yaffe et al. (2003) demonstrated that computer-aided analysis of mammographic images significantly enhances diagnostic accuracy. In particular, automated analysis minimizes human bias and increases the objectivity of diagnostic results.

RESEARCH DISCUSSION

This study focuses on the “Medical Image Detection Algorithm” program, which was developed as a practical tool for the early detection of breast cancer. According to statistical data, if the disease is identified at an early stage (stage 0 or I), the five-year survival rate of patients can reach 100%. However, this survival rate drops drastically as the cancer progresses to more advanced stages. Therefore, early detection is essential not only for improving individual patient outcomes but also for enhancing the efficiency and cost-effectiveness of the healthcare system.

The proposed program was developed using Python and integrates several key libraries, including OpenCV, Pillow, NumPy, and Tkinter. It enables users to load, analyze, and segment mammographic images. The system automates the entire workflow — from basic image preprocessing to morphological filtering, contour detection, and the measurement of tumor dimensions (diameter, surface area) as well as cancer staging [3].

Geometric Dimensions of a Tumor

To determine the geometric dimensions of a tumor, it is first necessary to compute its surface area and diameter (or volume, if applicable). If the tumor is modeled as a sphere, its surface area and volume can be calculated using the following formulas:

$$A = 4\pi \left(\frac{D}{2}\right)^2$$

Here A is the surface area, D is the diameter.

b) Volume of a sphere . If the tumor volume is spherical, the following formula is used to calculate the volume [4]

$$V = \frac{4}{3}\pi \left(\frac{D}{2}\right)^3$$

Here V is volume, D is the diameter.

Tumor growth rate . A logarithmic growth model can be used to analyze the growth rate of a tumor. If the diameter of a tumor increases over time, the following formula can be used to determine its growth rate [5]

$$D(t) = D_0 \cdot e^{kt}$$

Here D(t) — time t - is the diameter of the wire, — initial diameter, k — growth rate, t — time.

This model allows you to predict the growth of a tumor over time. For example, if you have the initial diameter of a tumor and its growth rate, you can use this formula to predict future growth patterns[6].

Tumor staging. The stage of a tumor and its degree of development are often determined using geometric measurements (diameter or volume). If you calculate the dimensions of the tumor and relate them to their clinical stages, the following formula can be used to classify the stages mathematically. a) Template for stages. The diameter D of a tumor can be used to determine its stage. For example, the stages of a tumor can be classified as follows [7]

$$Stadiya = \begin{cases} I \text{ bosqich,} & \text{agar } D < 20mm \\ II \text{ bosqich,} & \text{agar } 20 \geq D < 50mm \\ III \text{ bosqich} & \text{agar } D \geq 50mm \end{cases}$$

Here D is the diameter of the o'string , and its value determines the stage of the o'string . Stage I includes small-sized tumors, stage II includes medium-sized tumors, and stage III includes large-sized tumors.

Geometric evolution of a tumor. Evolutionary models can be used to analyze the growth and development of a tumor. Here, changes in the growth rate and size of the tumor are analyzed. If the growth rate of a tumor depends on time, its growth process can be represented by the following mathematical model[8]

$$V(t) = V_0 \cdot e^{kt}$$

Here V(t) — time t - the volume of the bottle, — initial volume, k — growth rate, t is time.

When it is necessary to analyze a tumor image through image processing techniques, various mathematical and algorithmic approaches can be applied. Algorithms such as edge detection, contour extraction, and optical

character recognition (OCR) can be utilized to segment geometric shapes (e.g., circles, spheres) and measure their dimensions in pixel units. Through such analysis, it is possible to determine the pixel resolution, calculate pixel-wise areas, and then derive the geometric parameters of the tumor, such as diameter, surface area, and volume.

Medical Image Disease Detection Algorithm Program

The Medical Image Disease Detection Algorithm program is specifically designed for the early-stage detection of breast cancer, while also enabling user data registration and management. The software is structured into three core components:

Registration

Window

In this section, the user enters personal information and reports symptoms related to the disease. The collected data is stored securely in an SQL database.

Disease

Information

Window

This section provides educational content on breast cancer, including its causes, common symptoms, and diagnostic procedures [9].

Main

Interface

Pages

This component allows users to interact with the core functionalities of the system, such as image selection, enhancement, and analysis.

How to Use the Program

The step-by-step usage of the program is as follows:

The user inputs personal and symptomatic information into the registration section.

A mammogram image is selected using the "Select Image" button.

The selected image is displayed in the central interface window.

Image enhancement operations — such as contrast adjustment, noise reduction, and boundary detection — are performed by clicking the "Enhance Image" button.

These features collectively automate the image preprocessing steps and provide a foundation for accurate and objective tumor detection and classification.

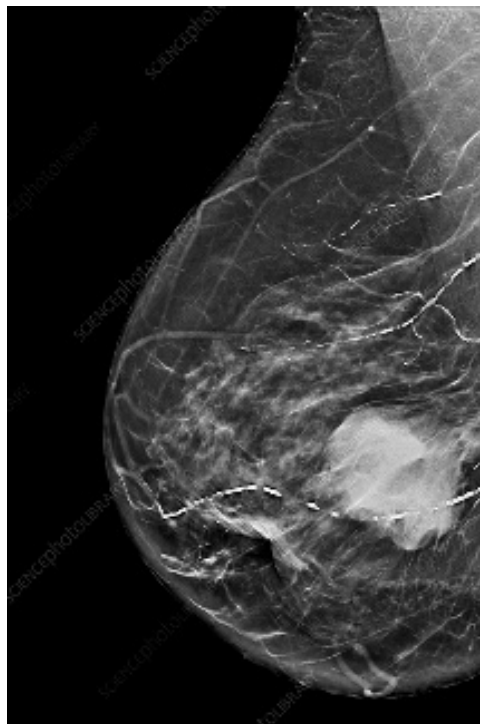


Figure 1. (Mammography image)

For example , this in the picture chest diaper cancer available . Add it to the program after loading then , your screen bottom in part tumor diameter , 2D area size and his/her general size about information appearance will be . Image next to and grow up located place and his/her segmented image reflection [10].

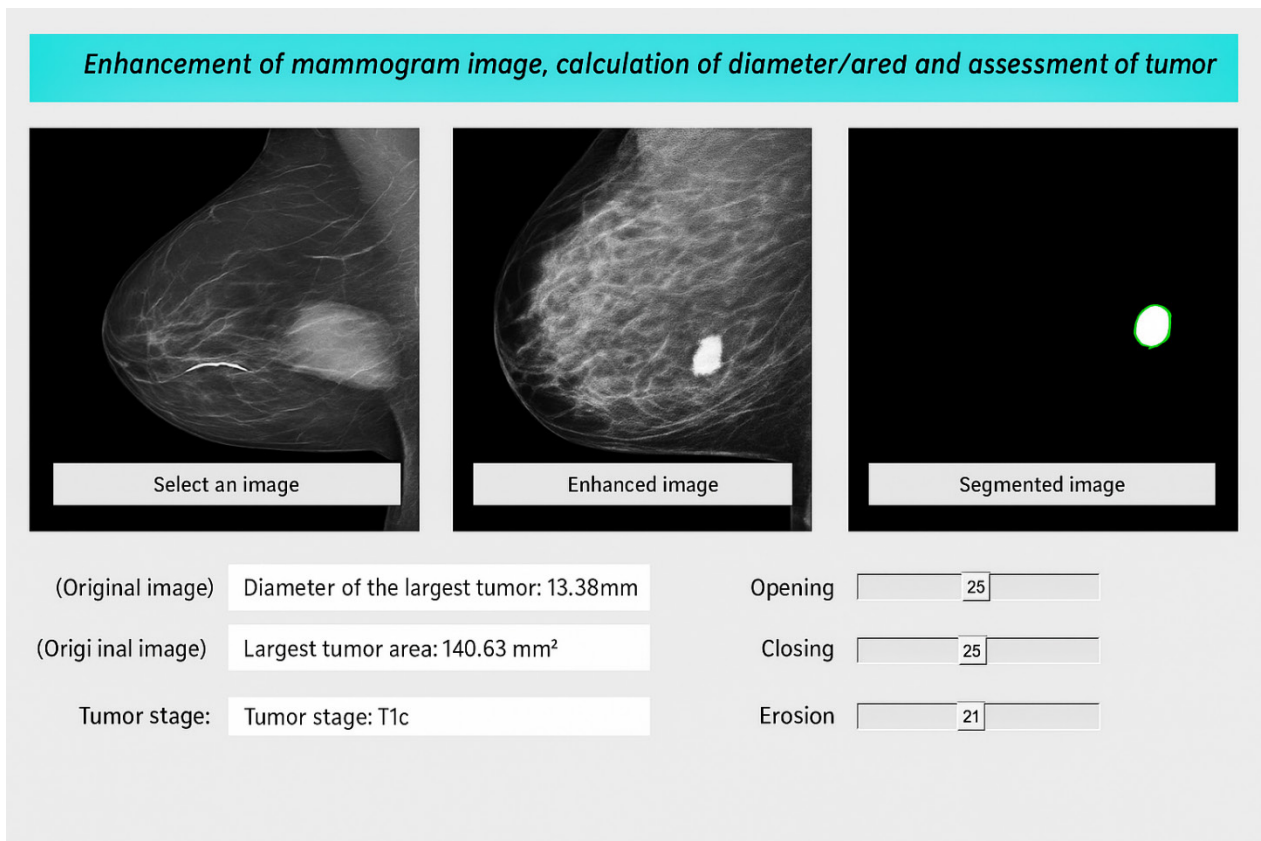


Figure 2. (Program result)

Home page bottom in part program the results see possible . If you grow there is if so , its status about information to take You can also grow diameter , 2D area and his/her stage about information to take possible . "O'sma" diameter " parameter your tumor approximate diameter shows . " 2D growth "area " parameter his/her the surface "O'sma" means "to grow up". " step " parameter and your tumor development stage guess does [11].

Grow up stage following algorithm based on is designated – T0 stage – tumor no . Stages T1, T1a, T1b, T1c – the tumor diameter very small (0-2 cm) . Stage T2 – growth The tumor is larger than 2 cm but smaller than 5 cm in diameter . Stage T3 – tumor diameter greater than 5 cm . This algorithm tumor determination for main criterion is , its to the size related without stage is marked . Other in the example checking Let's see [12].

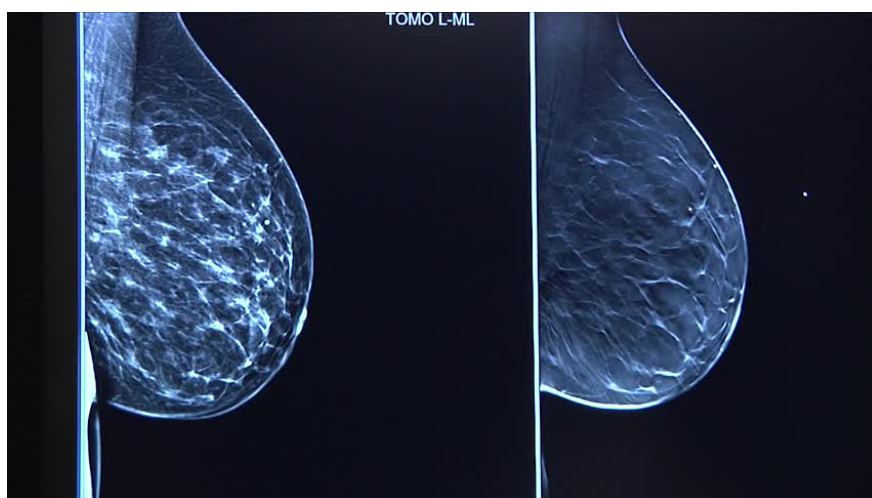


Figure 3 (Mammography) image)

Above mammography in the image growth there is This is not the image to the program after loading then result on the screen reflection The screen bottom In the section " O'sma" " not determined " message appearance will be .

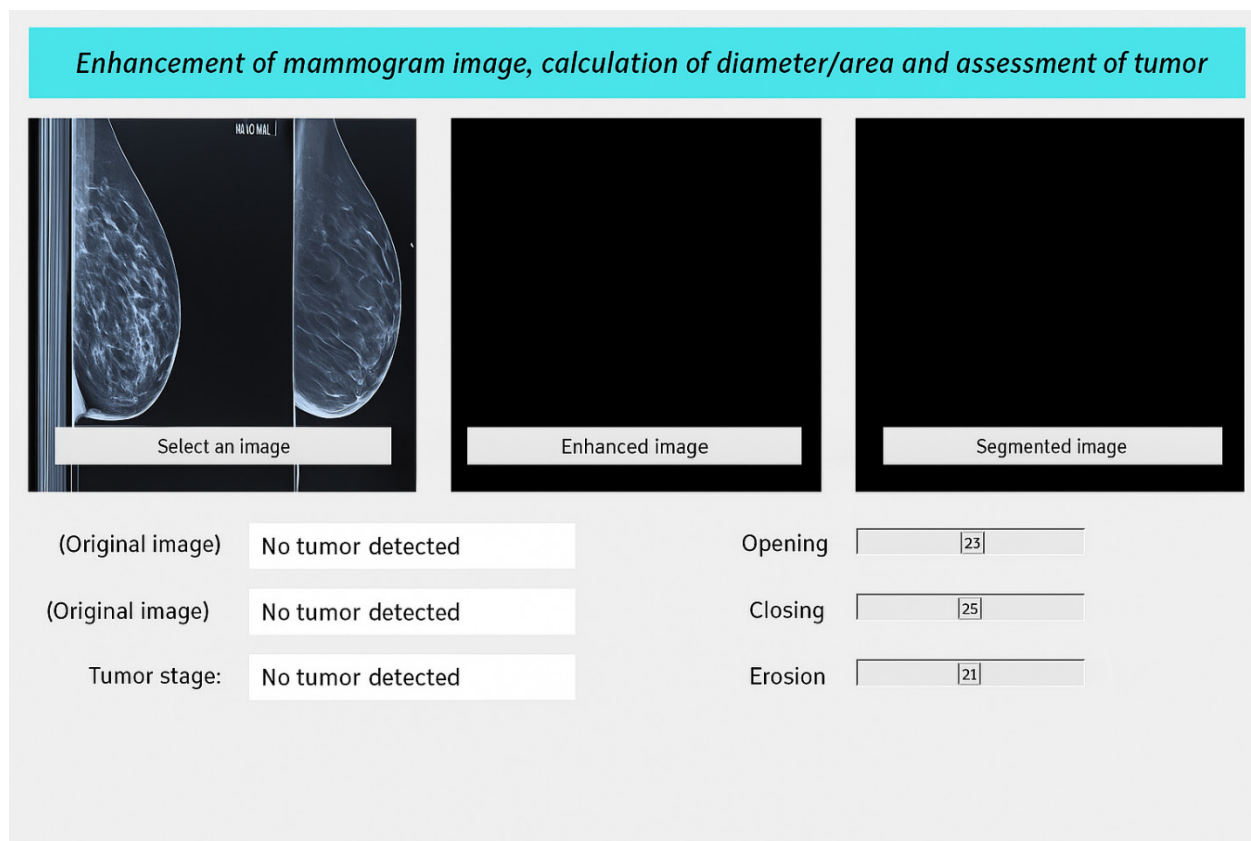


Figure 4 (Program result)

Above in the picture morphological operations The program displays the images . more precisely analysis to do for morphological also uses filters . Opening – small defects disappearance for is used . Closing – object contours to improve help Erosion – small objects take throw or contours separate show for is used [13].

Research results this shows that it works issued program

Blueberry diaper cancer mammographic images based on in determining high accuracy with works ;

In pictures growth existence determine , size calculation and stage determination opportunity gives ;

Diagnostics process accelerates and to users comfortable interface presented will come ;

Medicine employees work lightening , human to the factor related mistakes reduces . From the program use opportunities wide to be , to be hospitals , clinics and health storage in projects effective application possible . In the future this to the system artificial intellect algorithms integration through further progressive analysis and forecast opportunities This is especially true for medical resources limited in the regions health storage of services quality to increase service does [14].

CONCLUSION

Blue crack diaper cancer early identification – patient his life save stay and the disease in treatment the most important from factors is one of them . Research this shows that the disease is at stage 0 or I when detected safe stay The rate is close to 100%. This will be in the article working “Medical” images through diseases determination “algorithm “ program milk diaper cancer early in stages determination opportunity The program provides Tkinter , OpenCV, Pillow and other Python libraries based on working issued to users mammographic images upload them analysis to do , to grow existence determination , diameter and 2D space calculation opportunity gives . In the program used the image again work algorithms (thresholding, morphological filters , contour detection) and intuitive graphic interface medicine to employees diagnosis in the process help giving , human to the factor related mistakes to reduce service does . Currently program classic to methods based although , in the future artificial intellect and deep study models integration to do opportunity available [15].

Offers . Artificial intellect Integration - CNN (e.g. ResNet , VGG, EfficientNet) models into the program integration to do through mammographic images further accuracy with analysis to do This program is possible . cancer morphological types distinction opportunity gives . Information base expand - With the program used medical images number multiplied , various young groups , morphological types and in stages tumor

samples cover received big information base formation recommendation Cloud technologies based on the system improvement - program functions web application in appearance working exit through him/her remotely standing use opportunity is created , this especially medical experts insufficient in the regions useful .

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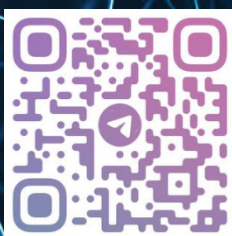
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