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Diagnostic Algorithm for Early Detection of Breast Cancer Based on Error Minimization Approach

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Abstract:- The relevance of the study lies in the fact that breast cancer is one of the most common oncological diseases among women, millions of women are diagnosed with it every year. Early detection is important in this disease, because if the disease is detected at an early stage, the chances of treatment are much higher. The study examines the use of artificial intelligence algorithms, in particular, ways to automate the process and improve accuracy based on interviewing users using a program created in Python. The practical significance of this scientific work lies in the fact that it proposes algorithmic approaches aimed at improving the early detection of breast cancer and improving the quality of life of patients by reducing errors. This scientific work is devoted to the development of diagnostic algorithms based on minimizing errors in early detection of breast cancer. The importance of diagnosis for early detection of breast cancer is considered and special attention is paid to the development of diagnostic software. This software package collects information about breast cancer and creates an algorithm that supports its diagnosis and treatment.

Keywords:- *Breast Cancer, Diagnosis, Algorithm, Software, Data Collection, Parameters, Classes, Objects.*

I. INTRODUCTION

Breast cancer (mammacarcinoma) is one of the most common oncological diseases among women and has a negative impact on the lives of millions of people around the world. According to the World Health Organization, the incidence of breast cancer is increasing every year, which makes early detection of the disease even more important[1-2]. Cases of breast cancer detected early are often able to be successfully treated, but detection of the disease in late stages significantly increases the risk of death.

This article examines the importance of artificial intelligence and deep learning algorithms in the early detection of breast cancer, how they work, and how to minimize errors while using the software. The goal is to combine traditional methods with artificial intelligence to increase the accuracy of diagnosis and provide more effective care to patients[3-4].

- *Data Collection –*

Improving detection of breast cancer and collecting data through the census is essential. The data collection process is important for improving breast cancer detection and automating the diagnostic process. Once medical images, demographics, medical history, and lifestyle data are collected, their proper storage and analysis can increase the chances of early disease detection[5-6]. This plays an important role in improving the quality of life of patients.

- *Creating an Algorithm –*

Based on the latest scientific achievements and clinical practices, the process of creating an algorithm for early detection of breast cancer includes the following main steps. Below are general steps and recommendations for creating an algorithm.

- *Software Development –*

According to the parameters defined in the algorithm, the software is developed. This application can act as a platform and application that can accept clinical contracts and medical presentations.

- *The Object of the Study –*

Breast cancerdisease preventionearly diagnosis of objects, determining the importance of objects and signs, information measurement criteria and algorithms, approaches based on the selection of sets of signs were obtained.

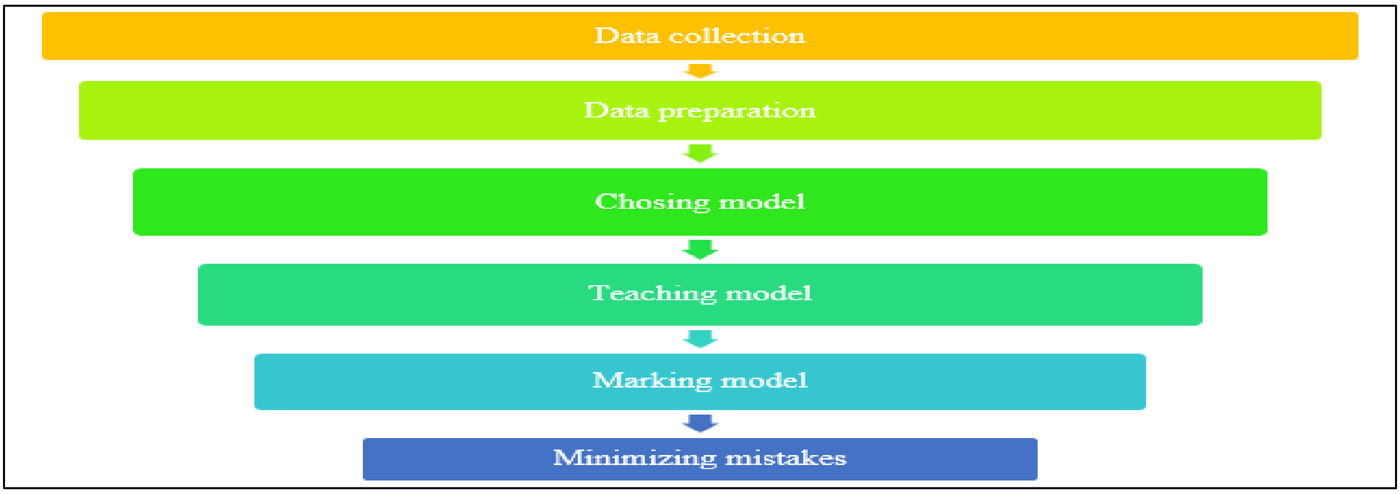

Fig 1 Data collection

➢ *Subject of Research* -

Breast cancerdisease preventionconsists of information measurement criteria and algorithms of the importance of objects in the early diagnosis of diseases.

➢ *Research Methods*

In the research process, the methods of information knowledge, intellectual analysis, and the theory of symbol recognition were used.

➢ *Scientific Novelty of the Research* –

Consists of:breast cancer preventionheuristic criteria and algorithms for determining the importance of objects and symbols in the early diagnosis of patients' diseases were analyzed[7-8].

- The research will develop an algorithm with real-time analysis capabilities, which will allow rapid diagnosis of patients in clinical practice and timely initiation of treatment.
- In the field of combination of methods and algorithms of intelligent data analysisbreast cancer preventionan algorithm for determining the information dimension of the importance of objects has been developed;

Practical results of the researchconsists of the following.

Breast cancer preventionA software complex has been developed that helps to automate medical diagnosis processes and make a final diagnosis based on information measurement criteria and algorithms for assessing patients' disease levels.[9-10].

Problems related to early diagnosis were solved as a result of applying the software complex to solving practical problems of the medical field.

➢ *Scientific and Practical Significance of Research Results.*

Scientific significance of research resultsbreast cancer preventionis a complex research that intersects with different fields such as signal processing, data science, and artificial intelligence. Scientific significance of such studiesbreast cancer preventionis to develop and develop algorithms that can efficiently and perfectly determine the initial indicators of[11-12].

Table 1 Breast Cancersymptoms

No	**Breast cancersymptoms (naming characters)**	**Possible values of characters**
1	Do you have general weakness?	1. No 2. Light (medium) 3. Strong
2	How long have you been diagnosed with the disease?	1. No disease 2. From 3 to 6 months 3. From 6 months to 1 year 4. From 1 to 3 years
3	Have you had any diseases in your family (mother-sisters, aunts)?	1. No 2. Yes
4	Do you have pain in the lower part of the shoulder?	1. No pain 2. The pain is moderate 3. The pain is intense
5	What is your breast size?	1. The same 2. One is bigger than the other 3. Both are enlarged
6	Do you have bad habits (Smoking, drinking alcohol, etc.)?	1. No 2. Yes

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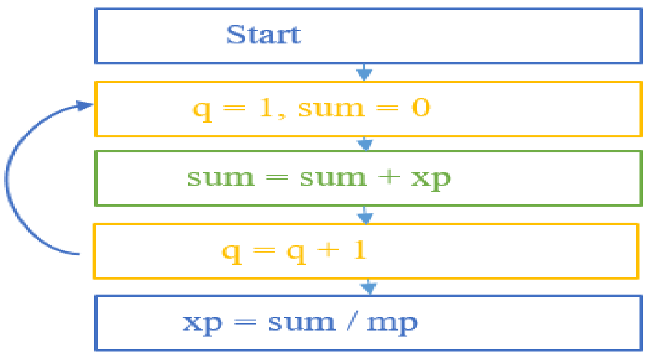
7	Do you use household services (manicure, pedicure, piercing, tattoo, etc.)?	1. No 2. Rarely 3. Too many
8	Do you have pain in your breast?	1. No 2. Medium 3. Nomadic
9	Do you have itchy breasts?	1. No 2. There is
10	Do you have chronic gynecological diseases?	1. normal (good) 2. Serveset 3. Endocerbicitis 4. Uterine frostbite 5. Ovarian cyst 6. Irregular passage of Hayes
11	Have you ever had a series of induced abortions in your lifetime?	1. No 2. Failure to develop the fetus 3. Forced abortion 4. Miscarriage 5. Causes of TORCH-infections
12	Have you ever had a breast-related injury in your life?	1. No 2. Yes
13	Are there any changes in your nipples or teats?	1. No change 2. Sucker pulled in 3. The teat is not pulled in 4. Wounded change 5. The nipple is cut
14	Do you notice a lump in your breast?	1. No 2. Yes
15	Does the mammary gland move when you hold it?	1. No 2. Yes
16	Are the boundaries of the tumor in the mammary gland clear?	1. No 2. Yes
17	What is the condition of the tumor in the mammary gland	1. Tumor burden 2. The tumor is soft 3. The tumor is solid
18	To save you regularly contraception or whether you take therapeutic hormone drugs	1. No 2. Yes

II. METHODOLOGY

➢ *Creating an algorithm*

- *Formula 1. $x_p$the coefficient of similarity of objects is determined.*

$$\boldsymbol{X_p} = \frac{1}{m_p}\sum_{q=1}^{m_p} x_p \tag{1}$$



➢ *Block Diagram of the Formula*

1st block scheme (determining the similarity coefficients of objects) $m_p = 42$ object number,$q = 1$ initial value ω_1 $ustun$ For 1st grade $\frac{1}{m_p}\sum_{q=1}^{m_p}(x_{p,}) = \frac{1}{42}\sum_{q=1}^{42}[x_1 + x_2 + \cdots + x_{42}]$ So, the following class columns are similar$\omega_{1\,,}, \omega_{2\,,} .., \omega_{18}$ considered objects X_1classare the most common character classes for objects. $m_p = 52$ object number,$q = 1$ initial value ω_1 $ustun$ For 2nd grade $\frac{1}{m_p}\sum_{q=1}^{m_p}(x_{p,}) = \frac{1}{3}\sum_{q=1}^{52}[x_1 + x_2 + \cdots + x_{52}]$

So the following class columns are similar$\omega_{1\,,}, \omega_{2\,,} .., \omega_{18}$ considered objects X_2classare the most common character classes for objects. $m_p = 20$ object number,$q = 1$ initial value ω_1 $ustun$ 2 for 3rd grade.$\frac{1}{m_p}\sum_{q=1}^{m_p}(x_{p,}) = \frac{1}{3}\sum_{q=1}^{20}[x_1 + x_2 + \cdots + x_{20}]$ So ω_1 = (2 3 2 3 3 2 2 2 1 2 3 2 1 2 2 2 1 2 2) $\omega_{1\,,}, \omega_{2\,,} .., \omega_{18}$

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Similar in the following class columnsconsidered objects X_3classare the most common character classes for objects.

By calculating in the following sequence, we obtain the following table The following table shows the set of objects that occur most frequently in the ωu columns of the breast cancer data objects.

III. RESULTS AND DISCUSSION

Table 2 Set of Most Common Objects

Do you have general weakness?	How long have you been diagnosed with the disease?	Have you had any diseases in your family (mother-sisters, aunts)?	Do you have pain in the lower part of the shoulder?	What is your breast size?	Do you have bad habits (Smoking, drinking alcohol, etc.)?	Do you use household services (manicure, pedicure, piercing, tattoo, etc.)?	Do you have pain in your breast?	Do you have itchy breasts?	Do you have chronic gynecological diseases?	Have you ever had a series of induced abortions in your lifetime?	Have you ever had a breast-related injury in your life?	Are there any changes in your nipples?	Do you notice a lump in your breast?	Does the mammary gland move when you hold it?	Are the boundaries of the tumor in the mammary gland clear?	What is the condition of the tumor in the mammary gland	Do you regularly take konroceptm hormone preparations for maintenance?
X1	X2	X3	X4	X5	X6	X7	X8	X9	X10	X11	X12	X13	X14	X15	X16	X17	X18
Class 1 (object)																	
2	3	1	2	2	1	1	2	1	1	1	2	3	1	1	2	3	1
2nd class (object)																	
2	4	1	1	1	1	1	1	1	1	1	1	1	2	2	2	3	1
3rd class (object)																	
2	4	1	2	2	1	1	2	1	1	1	1	2	2	2	2	3	1
4th grade (object)																	
3	3	1	3	2	1	1	3	1	1	1	2	3	2	1	2	3	1
5th grade (object)																	
2	2	1	2	1	1	1	2	1	1	1	1	2	2	1	2	3	1
6th grade (object)																	
3	3	1	3	2	1	1	3	1	3	1	2	3	1	1	2	3	1
7th grade (object)																	
3	3	1	1	1	1	1	1	1	1	1	1	1	2	1	1	3	1
8th grade (object)																	
3	4	1	3	1	1	1	3	1	1	1	1	1	2	1	1	3	1
9th grade (object)																	
3	4	1	3	1	1	1	3	1	1	2	1	2	2	2	2	3	1
10th grade (object)																	
2	3	1	1	2	1	1	1	1	3	1	1	2	2	1	1	3	1
11th grade (object)																	
2	4	1	2	1	1	1	2	1	1	1	1	1	2	2	2	2	1
12th grade (object)																	
2	4	1	2	1	1	1	2	1	1	1	1	1	2	1	1	3	1

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- *Formula 2. Evaluates the Equality of the Corresponding Components of the Object in Two.*

$$(x_i, x_k) = \begin{cases} 1 \text{ if } & x_i^j = x_k^j \ , j = \overline{1, N}. \\ 0 & \text{else} . \end{cases} \quad (2)$$

For example, let's compare the newly added objects to class 1

1.Newly entered = (2 3 2 3 3 2 2 2 1 2 3 1 1 3 3 2 1 2 1)$x_1, x_2, x_3, x_4, x_5, x_6, x_7, x_8, x_9, x_{10}, x_{11}, x_{12}, x_{13}, x_{14} x_{15}, x_{16}, x_{17}, x_{18}$

2. most common objects = (2 3 3 3 3 2 1 2 1 2 3 3 1 3 3 3 1 2

1)$\omega_1, \omega_2, \omega_3, \omega_4, \omega_5, \omega_6, \omega_7, \omega_8, \omega_9, \omega_{10}, \omega_{11}, \omega_{12}, \omega_{13}, \omega_{14} \omega_{15}, \omega_{16}, \omega_{17}, \omega_{18}, \omega_{19}$

$x_1 = \omega_1, x_2 = \omega_2, x_3 = \omega_3, x_4 = \omega_4, x_5 = \omega_5, x_6 = \omega_6, x_7 = \omega_7, x_8 = \omega_8$

$x_9 = \omega_9, x_{10} = \omega_{10}, x_{11} = \omega_{11}, x_{12} = \omega_{12}, x_{13} = \omega_{13}, x_{14} = \omega_{14}, x_{15} = \omega_{15}, x_{16} = \omega_{16}, x_{17} = \omega_{17}, x_{18} = \omega_{18}$

X_u = {1 1 0 1 1 1 0 1 1 1 1 0 1 1 1 0 1 1 1 }

Here it is if the corresponding components of the object in I kki are equal to each other. So the difference between the two$(x_i, x_k) = 1 x_i = x_k \mu$checks a single component,$\varkappa$and size means the number of identical components of objectsx_i, x_k[13-14].

- *Formula 3. The optimization problem for identifying an informative character set is as follows:*

$$\begin{cases} (x_p, x_k) = \max\limits_{\lambda \in \Lambda^\ell} \sum\limits_{i \neq k=1}^{m_p} \sum\limits_{k=i+1}^{m_p} \frac{\varkappa(x_p, x_k) * 100\%}{N} \\ \lambda \in \Lambda^\ell = \left\{ \lambda : \sum\limits_{j=1}^{N} \lambda^j = \ell, \ \lambda^j \in \{0,1\}, j = \overline{1, N} \right\}. \end{cases} \quad (3)$$

$$\sum_{j=1}^{N} \lambda^j = \ell 1 + \ell 2, \dots, \ell n = 1+1+0+1+1+1+0+1+1+1+1+0+1+1+1+0+1+1+1 = 15$$

Newly introduced objects are compared and aggregated.

$$v(x_i, x_k) = \frac{\varkappa * 100\%}{N}$$

$$(x_i, x_k) = \frac{\varkappa * 100\%}{N} = \frac{15 * 100}{19} = 78.9\%$$

The number of parameters is N = 18 through the formula 3 below

X_p = {1 1 0 1 1 1 0 1 1 1 1 0 1 1 1 0 1 1 1 } we perform the following calculations

X_p = {1 1 0 1 1 1 0 1 1 1 1 0 1 1 1 0 1 1 1 }= 1 +1 + 0 + 1 +1 +1 +0 +1+ 1 +1 +1 +0 +1 +1 + 1+ 0+ 1+ 1+ 1 = 15

For example, newly introduced to the 1st gradeFinding the object's percentage of closeness to cash is calculated as follows

$$\boldsymbol{X_p} = \max_{\lambda \in \Lambda^\ell} \sum_{i \neq k=1}^{m_p} \sum_{k=i+1}^{m_p} \frac{X_p * 100\%}{N} = \frac{15 * 100\%}{18} = 79\ \%$$

X_p our object is 79% percentage, we will make a diagram of the remaining classes using the following formula.

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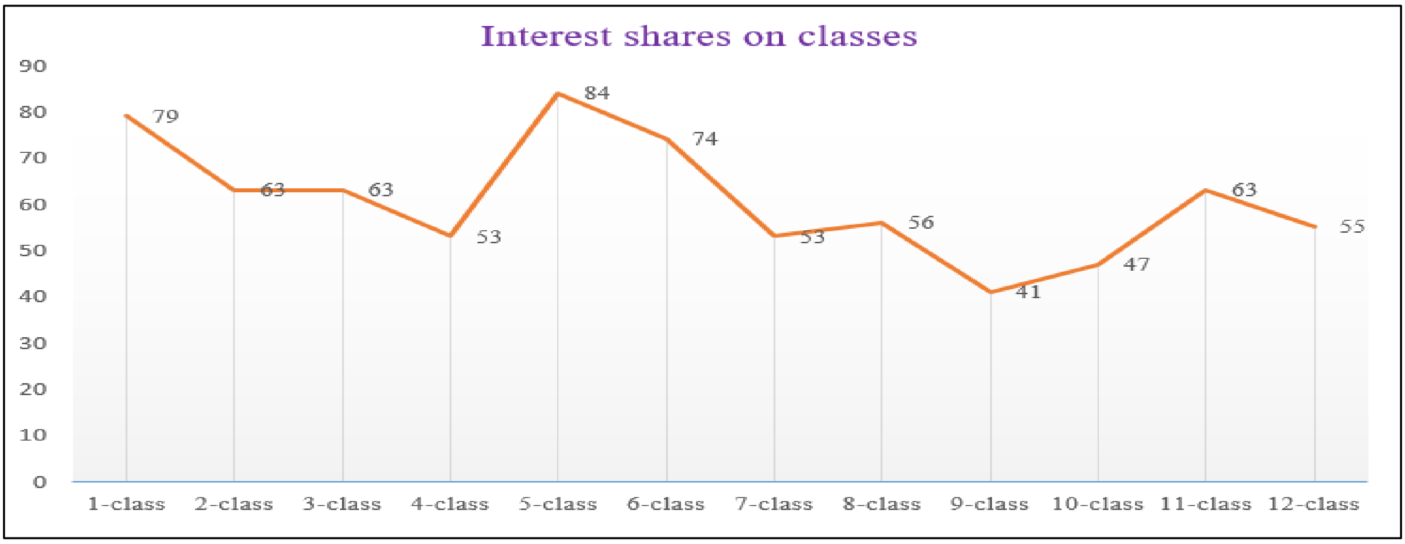

Fig 2 Interest Shares on Classes

$$a_p^j = \sum_{q=1}^{m_p} \rho_p^j(x_{p,}x_q), \mathrm{i} = \overline{1, \mathrm{m_p}}\,, \qquad j = \overline{1, N}. \qquad (4)$$

If we expand this expression, it forms a matrix.$(m_p \times N)$

In the first row of the matrix there is an estimate of the degree of similarity in the cross-section of the parameters of the objects of the object class, and in the second row there is an estimate of the degrees of similarity in the cross-section of the parameters of the class objects of the second object, and the similarity in the cross-section of the parameters of the class objects of the object The price is located in the cross-section of levels$x_{p1} X_p x_{p2} X_p m_p x_{pm_p} X_p$[15-16].

Formula 5. Formula 4 above from these designations ie In recognition of symbols with nominal information **3 -** in a way that uses a functionalthe issue of choosing informative signs,$X_p$in the section of class objectsto solve the following optimization problem.

$$\begin{cases} \dfrac{1}{m_p}\displaystyle\sum_{i=1}^{m_p} (a_{pi}, \lambda) \to max \\ \lambda \in \Lambda^{\ell} = \left\{ \lambda\colon \displaystyle\sum_{j=1}^{N} \lambda^j = \ell\,,\ \ \lambda^j \in \{0,1\}, j = \overline{1, N} \right\} \end{cases} \qquad (5)$$

By the formula belowobjectsthe largest class in is found and the newly introduced class belongs to the found class.

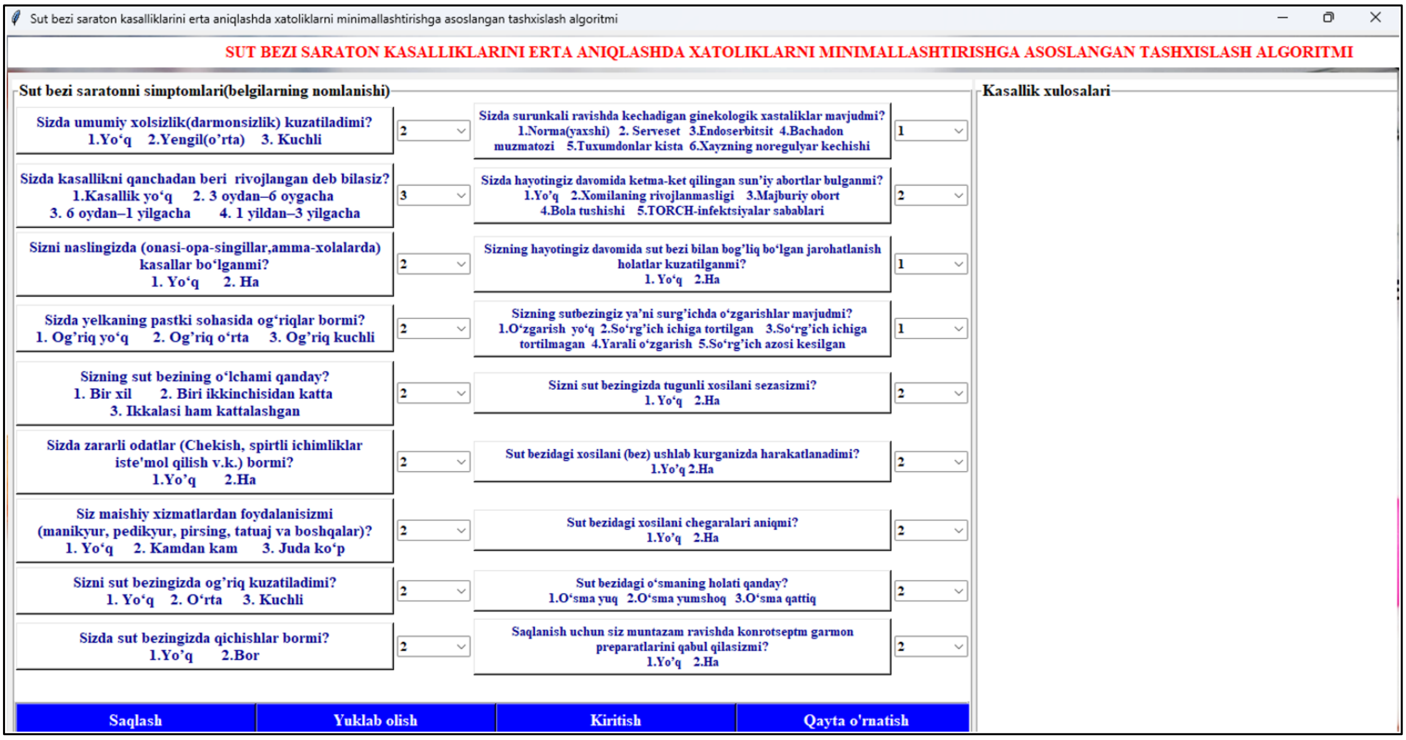

Fig 3 (Program Interface)

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IV. CONCLUSIONS

In conclusion, we can say that based on the above algorithms, the result of the program outputs the class to which the newly entered object belongs, and the software displays the result on the screen to determine which class it belongs to or not to diabetes through the extracted information. shows.

Early detection of breast cancer significantly increases the chances of patients recovering. In this process, the accuracy of diagnostic algorithms and minimizing errors are of great importance. In this study, a new algorithm based on minimizing errors in early detection of breast cancer was developed and its effectiveness was analyzed.

The algorithm was created by pre-processing data, selecting important features, training data, and model validation. In particular, several functions were optimized to minimize errors. The results show that an algorithm based on minimizing errors can be effective in early detection of breast cancer. This approach can be used as an additional support tool for doctors and diagnostic centers. The practical application of this algorithm will contribute to the automation of the early diagnosis process, cancer prevention, and improvement of the quality of life of patients.

In the future, it is necessary to improve this algorithm by involving more databases, using deep learning models, and taking into account the feedback of doctors. Thus, this research has great potential for digitizing and automating diagnostic processes in the medical field.

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