ISSN 2707-1898 (print)
ISSN 2786-9172 (online)

Український журнал інформаційних технологій
Ukrainian Journal of Information Technology

http://science.lpnu.ua/uk/ujit
https://doi.org/10.23939/ujit2025.02.035
Article received 02.10.2025 р.
Article accepted 30.10.2025 р.
UDC 004.4, 004.8

Correspondence author
O. M. Berezsky
olber62@gmail.com

O. M. Berezsky, P. B. Liashchynskyi
West Ukrainian National University, Ternopil, Ukraine

SOFTWARE SYSTEM FOR AUTOMATIC DIAGNOSIS OF BREAST CANCER

The extremely pressing issue of breast cancer diagnosis, which remains one of the leading causes of mortality, requires innovative approaches to improve the accuracy and speed of cancer diagnosis.

The paper substantiates the relevance of the problem of creating a comprehensive software system for automatic diagnosis of breast cancer, which is an important step in improving the accuracy and efficiency of oncological diagnosis. An approach to the development of such a system is proposed, which includes modules for biomedical image segmentation, classification, identification of informative features, automatic diagnosis, image synthesis, data set management, neural network models managements, metrics, and user management. The functional requirements for the software were developed and its architecture was designed in accordance with the principle of single responsibility: each module performs a clearly defined function, which ensures flexibility, scalability, and ease of further expansion of the system. The implementation was carried out in the form of a modern web application using Next.js, FastAPI, PyTorch, MongoDB, OpenCV, and Mantine UI technologies. The client-server architecture with support for cloud infrastructure allows for efficient processing of large amounts of medical data, ensuring reliability, performance, and high availability of the system. The database structure was designed in the form of a logical UML class diagram, which ensures reliable information management, support for CRUD operations, and compliance with the requirements for maintaining the integrity and confidentiality of medical data. Experimental studies have shown the effectiveness of neural networks in biomedical image segmentation and classification tasks, in particular for cell isolation, marker evaluation, and cancer subtype identification. The results of the study are of practical value and can be implemented in the activities of medical institutions, as well as used for the further development of intelligent decision support systems in the field of digital medicine.

Keywords: automatic diagnostics, neural networks, software system, image analysis.

Introduction

The growing popularity of information technology and artificial intelligence in the medical field opens up significant opportunities for improving the efficiency and accuracy of diagnosis.

Information technology is used for treatment planning and patient record keeping, storage and processing of medical data (medical history, test results, X-rays, etc.), telemedicine, and more [1].

In the context of breast cancer, which remains one of the most common cancers among women [2, 3], the development of automatic diagnostic systems is extremely relevant. Such a system can significantly speed up the process of detecting the disease, reduce the likelihood of human error, and promote timely treatment, which is critical for a successful outcome. Automatic diagnostic systems often use neural networks, which are widely used in the segmentation and classification of histological and immunohistochemical images [4–13].

A research group led by Professor Oleg Berezsky at the West Ukrainian National University has been working on the application of artificial intelligence in computer diagnostic systems for twenty years. A number of scientific papers by the research group describe methods, algorithms, and software tools for diagnosis in oncology [14–19].

The object of the study – is the development of an automatic breast cancer diagnosis system.

The subject of the study – is the methods and means of developing software for an automatic breast cancer diagnosis system.

The goal of the work – is to develop an automated breast cancer diagnosis system using artificial intelligence methods and tools, which will improve the accuracy of diagnosis through comprehensive image analysis, including segmentation, classification, identification of informative features, and diagnosis.

To achieve this goal, the following *main research tasks* have been identified:

- to analyze scientific works on computer diagnostics in medicine;
- to develop functional requirements for the software system;
- to develop the architecture of the software system and database architecture;
- to implement the system in software.

Materials and methods. The research was conducted using modern programming technologies, neural network theory, and machine learning methods. The Python programming language (FastAPI framework) and TypeScript (Next.js by Vercel framework) were used. The PyTorch framework was used to work with neural networks.

Analysis of recent research and publications. As a detailed analysis of studies [20, 21] shows, computer aided diagnosis systems (CAD) demonstrate a wide range of capabilities: from computer diagnostics and individual prognosis to functional assessment and segmentation of radiological structures. Examples of their successful application include the assessment of quantitative collagen content and blood vessel density [22], the detection of nodules in the lungs [23], as well as the differentiation of carotid artery atherosclerotic plaques and the diagnosis of focal liver lesions [24]. Some systems have already proven their ability to improve cancer detection sensitivity, as in the case of ImageChecker for mammography [25].

Particular attention is paid to the use of CAD in the diagnosis of breast cancer. Solutions based on deep belief networks for automatic recognition of normal, benign, or malignant areas [26] are proposed, as well as integrated medical imaging and analysis systems using digital image processing and artificial intelligence methods [27]. Importantly, recent developments, such as those using deep learning and explainable artificial intelligence (XAI) methods for ultrasound image analysis [28], demonstrate continued progress in this field.

Despite significant achievements, some studies, particularly those on commercial CAD for screening mammography [29], point to the need for further improvement of architectures to reduce false positives. This underscores the importance of ongoing research and development.

Considering the clinical aspects of breast cancer, risk factors, abnormalities, and the BIRADS system [30], as well as the existing problems with the application of convolutional neural networks for medical images, it becomes clear that the development of a comprehensive system for the automatic diagnosis of breast cancer is an extremely urgent task. Such a system has the potential to significantly improve early detection, increase diagnostic accuracy, and, as a result, contribute to more effective treatment and better outcomes for patients.

Research results and their discussion

Functional requirements. The automatic breast cancer diagnosis system should consist of the following modules: users, data sets, segmentation and classification, informative feature detection (determination of characteristic values), automatic diagnosis, image synthesis, models, and metrics (Table 1). Each module should allow users to create, retrieve, edit, and delete entities. In software engineering, this is called CRUD (create, read, update, delete).

Designing the architecture of the software system. The architecture of the software system is based on client-server technology. The architecture is shown in Fig. 1.

Table 1. System modules

Name	Purpose
Users	System user management
Datasets	Import of immunohistochemical and histological images
Models	Importing pre-trained neural network models
Segmentation	Automatic segmentation of immunohistochemical images using U-Net networks (ready-made or custom)
Classification	Automatic classification of histological images using convolutional neural networks (ready-made or custom)
Determination of characteristic values	Calculation of cell positivity and staining intensity based on the average intensity of each cell, used for further diagnostic analysis of immunohistochemical images
Automatic diagnostics	Comprehensive image analysis (includes all the functionality performed by the modules for calculating quantitative characteristics, segmentation, and classification)
Image synthesis	Image synthesis based on diffusion models (ready-made or custom)
Metrics	Comparison of images at low, medium, and high levels of computer vision. Different metrics are used for each level. The result of the comparison is a quantitative assessment of the similarity of images

The system is built on the principle of single responsibility, which is the first of the SOLID principles, and is focused on effective real-time interaction with the user.

Designing the architecture of the database. The logical diagram in the form of a UML class diagram is shown in Fig. 2.

Each entity is linked to the user via the *created_by* field and, additionally, to the user's organization via the *organization* field, and reflects the corresponding module in the software system.

MongoDB was chosen as the DBMS, which is a non-relational database with good optimization for high loads.

Software implementation. In accordance with the designed architecture of the software system (see Fig. 1), it is implemented in separate modules. Let's take a closer look at the client and server parts.

Client. This part is responsible for user interaction with the automatic diagnostic software system. The user can create, receive, edit, and delete entities as specified in the functional requirements.

The client part of the software system was implemented using the TypeScript programming language in combination with the Next.js framework. The Mantine UI library of ready-made UI components was also used. The program uses the Axios library for HTTP requests.

Server. The server part is implemented based on the FastAPI framework.

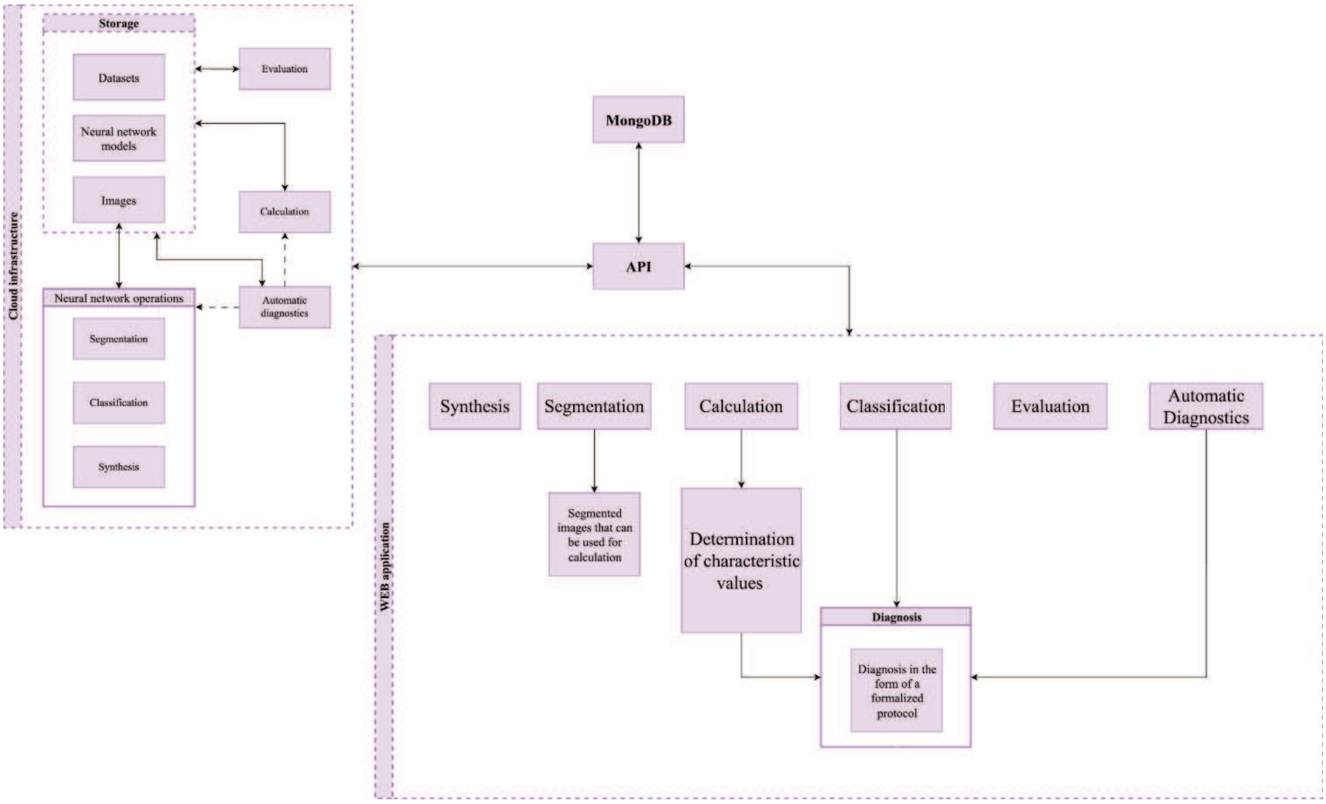

Fig. 1. Representation of the system architecture

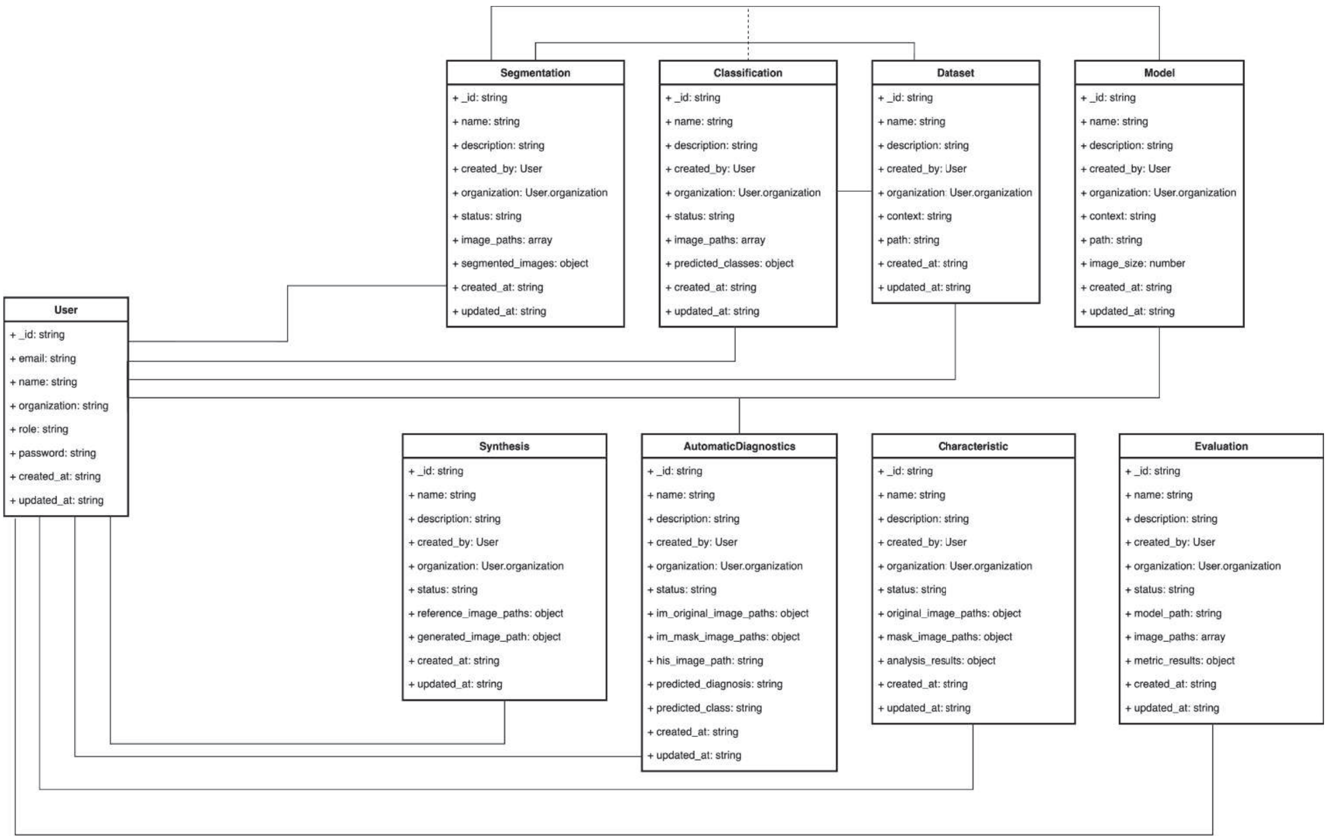

Fig. 2. Database logical model

The directory structure of the server part of the program is shown in Fig. 3.

The UML class diagram of the server part for working with images is shown in Fig. 4.

Computer experiments. As an experiment, let's perform classification, segmentation, and determination of informative features.

The classification research results page is shown in Fig. 5.

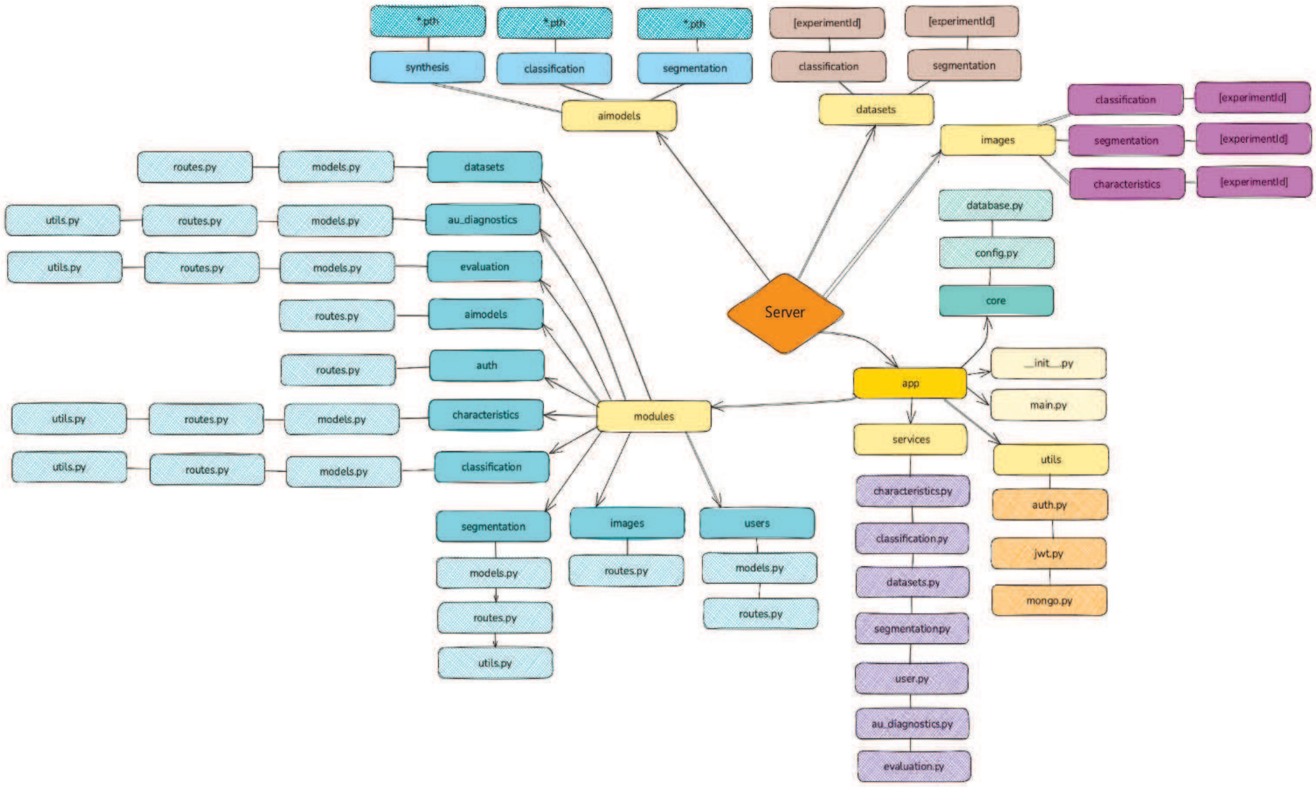

Fig. 3. Structure of server directories

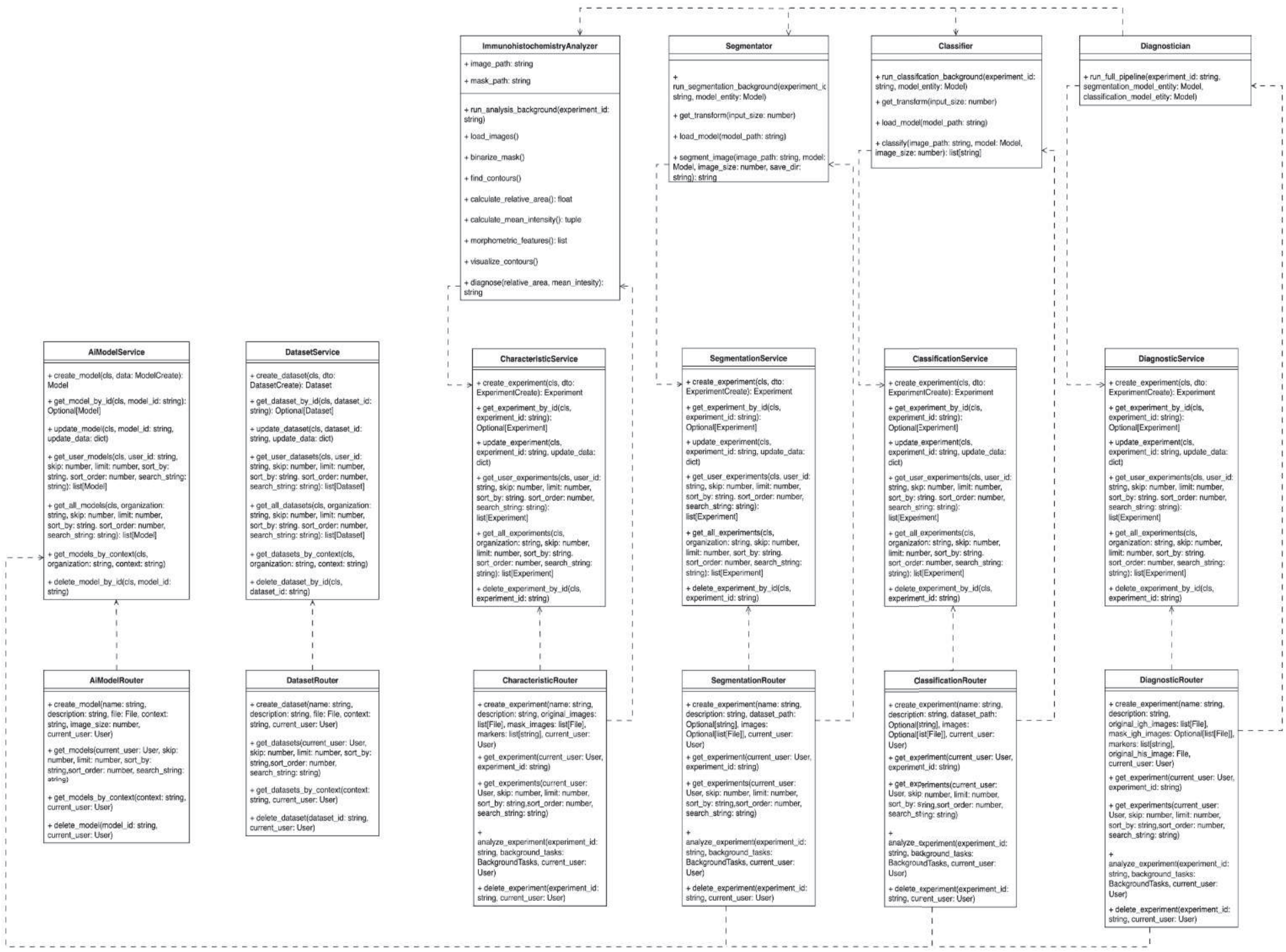

Fig. 4. UML diagram of the server part for image analysis

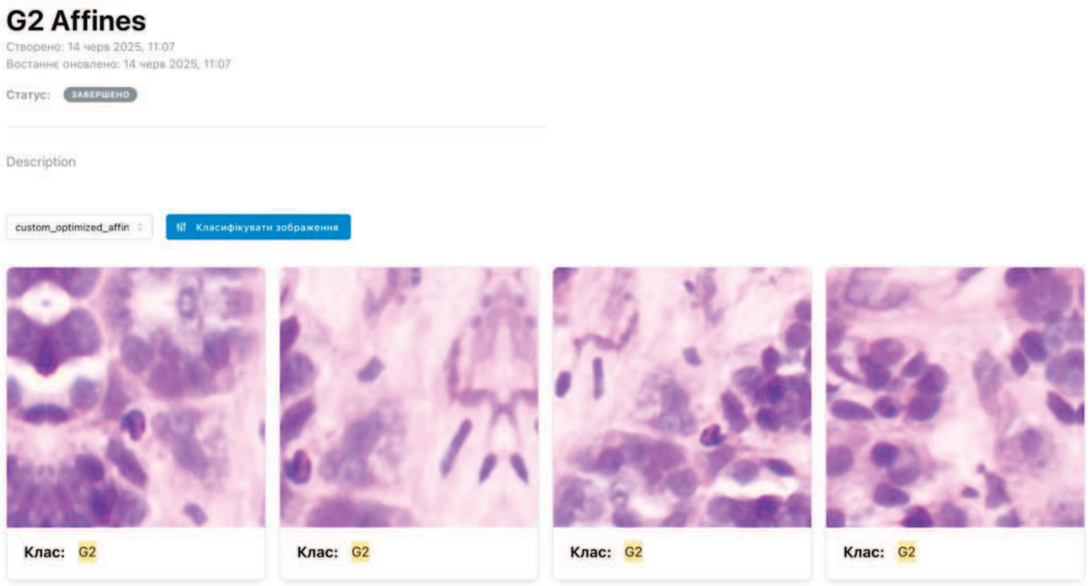

Fig. 5. Experiment page after classification is completed

The segmentation research results page is shown in Fig. 6.

The research page with the definition of informative features and the results obtained is shown in Fig. 7.

The automatic diagnosis result page window is similar to the one shown in Fig. 7. The classification result is additionally displayed at the bottom. The module uses segmentation (if the user does not have segmented images), classification, and informative feature detection. This is the main module of the system, which allows you to obtain a comprehensive result.

Discussion of the research results. The advantage of the developed software system is that the server part, along with complex calculations, is located in the cloud. However, if the user employs complex neural network models and calculations for high-resolution images (optimally 128 to 512 pixels), it may be necessary to transfer the generator, segmenter, and classifier to a separate cloud infrastructure.

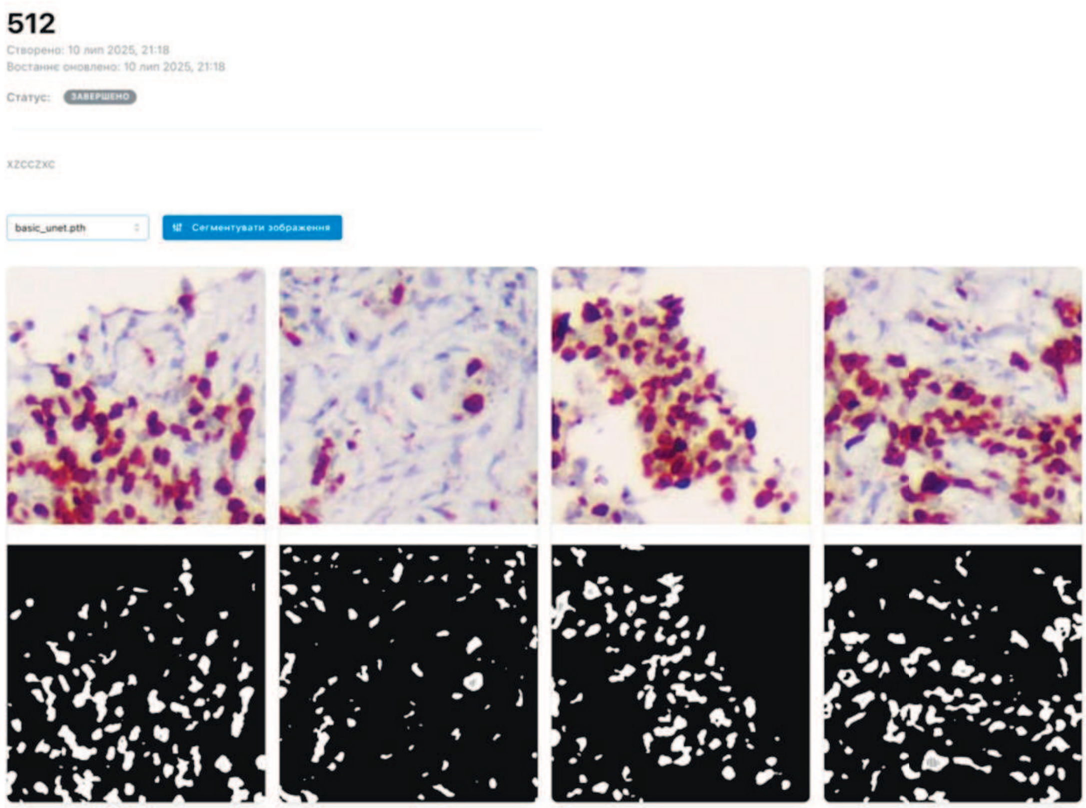

Fig. 6. Experiment page after segmentation is completed

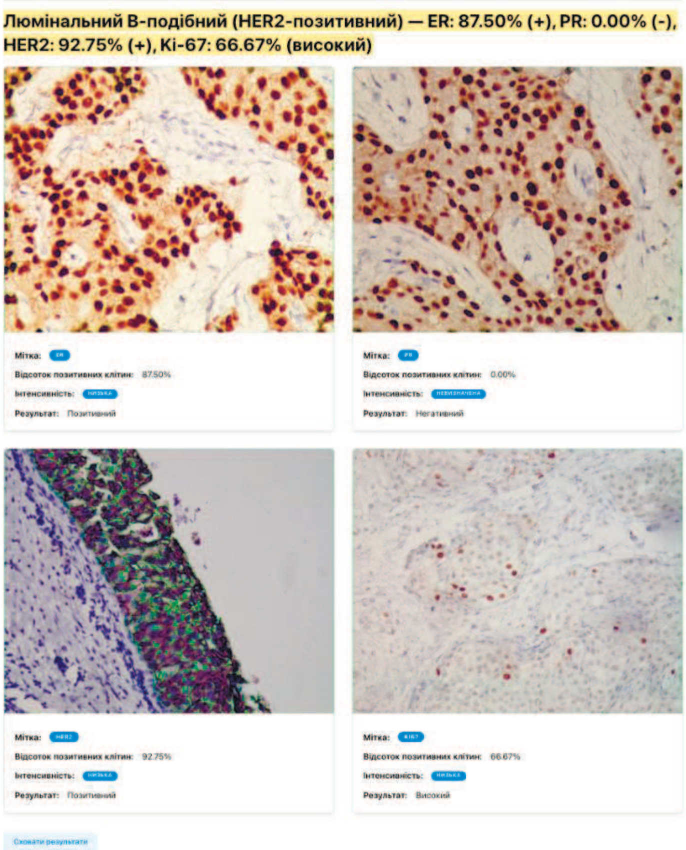

Fig. 7. Experiment page after definition of informative features is completed

It should be noted that neural networks are not trained directly from the system. The system uses pre-trained models that are simply hosted in the cloud. This is one of the advantages, as resources are not wasted on this task.

Table 2 compares the developed software system with existing solutions. The developed software system goes beyond standard commercial CAD systems that help radiologists detect suspicious areas on mammograms.

Table 2. Comparison of the developed software system with existing solutions

Comparison criterion	BRECCAD (developed CAD)	iCAD	Hologic Imagehecker	Aidoc	Zebra Medical Vision
Scope of application	Comprehensive analysis of histological and immunohistochemical images, segmentation, classification of breast cancer subtypes	Mammogram analysis	Mammogram analysis	Analysis of various types of medical images (CT, MRI)	Analysis of different types of medical images
Main focus	Analysis at the cellular and molecular levels, allowing cancer subtypes to be identified	Detection of formations at the macroscopic level (mammograms)	Detection of formations at the macroscopic level (mammograms)	Detection of a wide range of pathologies on CT / MRI	Detection of a wide range of pathologies on different images
Depth of analysis	Multilevel analysis: segmentation of immunohistochemical images, calculation of quantitative features, classification of histological images	Single-level analysis: identifying potential vulnerabilities	Single-level analysis: identifying potential vulnerabilities	Single-level analysis: detection of pathologies	Single-level analysis: detection of pathologies
Practical significance	Highest diagnostic accuracy thanks to the use of biologically significant features obtained from immunohistochemical images	Assistance to radiologists in detecting formations	Assistance to radiologists in detecting formations	Accelerating diagnosis, prioritizing critical cases	Assistance in early detection of diseases
Target audience	Oncologists, pathologists, researchers	Radiologists	Radiologists	Radiologists, emergency physicians	Radiologists

The approach developed is much more complex and scientifically sound, as it delves into the analysis of biological markers at the cellular level, allowing not only to detect cancer, but also to determine its specific subtype. This fundamentally distinguishes the developed system and makes it highly valuable for personalized medicine.

It is this integrated, multi-level analysis that is the main advantage of the developed software tool.

The scientific novelty of the research results lies in the further development of methods for the automatic diagnosis of breast cancer through the development of a comprehensive software system using modern biomedical image processing technologies based on neural networks.

In particular:

for the first time:

- a comprehensive approach to the automatic diagnosis of breast cancer has been proposed and implemented, covering the stages of segmentation of immunohistochemical images, detection of informative features, and classification of cancer subtypes on histological images, which improves the accuracy and validity of diagnostic decisions;
- an architecture for a scalable software system for medical diagnostic tasks has been developed, which takes into account the need for high performance and protection of confidential data, ensuring its suitability for use in clinical practice;
- a database structure has been developed that is focused on the efficient processing of large volumes of medical information, taking into account the requirements for the integrity and confidentiality of medical data;

improved:

- approach to data management in medical software systems, in particular, an effective user and image set management system has been implemented, which optimizes work with medical data and provides convenience for users;
- the functionality of web applications for medical diagnostics, in particular, the implementation of automatic image synthesis and the determination of informative features based on segmentation results, which allows for a higher level of automation in the diagnostic process;

have been further developed:

- approaches to building information systems in the field of digital medicine that integrate deep learning methods to improve the accuracy of biomedical image analysis and can be adapted to other types of cancer or medical tasks.

Practical significance of the results obtained. The main practically significant results of the study were obtained based on a combination of theoretical approaches and applied implementation in the field of medical informatics. The developed methods, algorithms, and architectural solutions are aimed at improving the effectiveness of software tools for automatic diagnosis of breast cancer based on the analysis of biomedical images using modern artificial intelligence technologies.

Conclusions

Within the framework of the proposed approach, a software system has been implemented that provides:

- automatic segmentation of immunohistochemical images, calculation of informative features, and classification of cancer subtypes, which reduces the influence of subjective human factors on diagnosis and improves the accuracy of clinical decision-making;
- centralized storage, management, and processing of medical images through an implemented database structure that supports efficient management of large amounts of data;
- a convenient web interface for medical professionals with functionality for managing datasets, users, and diagnostic histories.

The practical application of the results allows for increased accuracy in identifying breast cancer types and subtypes, which is critical for choosing a treatment strategy.

The developed software system can be used in educational, research, and clinical institutions, as well as serve as a basis for the further development of expert medical systems, particularly in the field of oncology.

References

1. Habuza, T., Al-Kafri, A., Alsalah, H., Al-Busaidi, S. S., Al-Rawahi, F. R., & Al-Marzooqi, F. I. (2021). AI applications in robotics, diagnostic image analysis and precision medicine: Current limitations, future trends, guidelines on CAD systems for medicine. *Informatics in Medicine Unlocked*, 24, 100596. https://doi.org/10.1016/j.imu.2021.100596
2. Nabok, A. I. (2023). Prevalence and incidence of breast cancer in Ukraine. *Wiad Lek*, 76(10), 2219–2223. http://dx.doi.org/10.36740/WLek202310114
3. Siegel, R. L., Miller, K. D., Wagle, N. S., & Jemal, A. (2023). Cancer statistics, 2023. *CA: a cancer journal for clinicians*, 73(1). https://doi.org/10.3322/caac.21871
4. Litjens, G., Kooi, T., Bejnordi, B. E., Setio, A. A. A., Ciompi, F., Ghafoorian, M.,… & Sánchez, C. I. (2017). A survey on deep learning in medical image analysis. *Medical image analysis*, 42, 60–88. https://doi.org/10.1016/j.media.2017.07.005
5. Srikantamurthy, M. M., Rallabandi, V. S., Dudekula, D. B., Natarajan, S., & Park, J. (2023). Classification of benign and malignant subtypes of breast cancer histopathology imaging using hybrid CNN-LSTM based transfer learning. *BMC Medical Imaging*, 23(1), 19. http://dx.doi.org/10.1186/s12880-023-00964-0
6. Al-Jabbar, M., Alshahrani, M., Senan, E. M., & Ahmed, I. A. (2023). Analyzing histological images using hybrid techniques for early detection of multi-class breast cancer based on fusion features of CNN and handcrafted. *Diagnostics*, 13(10), 1753. http://dx.doi.org/10.3390/diagnostics13101753
7. Miranda Ruiz, F., Lahrmann, B., Bartels, L., Krauthoff, A., Keil, A., Härtel, S.,… & Grabe, N. (2023). CNN stability training improves robustness to scanner and IHC-based image

variability for epithelium segmentation in cervical histology. *Frontiers in Medicine,* 10, 1173616. http://dx.doi.org/10.3389/fmed. 2023.1173616
8. Zaha, D. C. (2014). Significance of immunohistochemistry in breast cancer. *World journal of clinical oncology*, 5(3), 382. https://doi.org/10.5306/wjco.v5.i3.382
9. Aswathy, M. A., & Mohan, J. (2020). Analysis of machine learning algorithms for breast cancer detection. In Handbook of Research on Applications and Implementations of Machine Learning Techniques (pp. 1–20). IGI global. https://doi.org/ 10.4018/978-1-5225-9902-9.ch001
10. Dzulkifli, F. A., Mashor, M. Y., & Jaafar, H. (2021). Colour thresholding-based automatic Ki67 counting procedure for immunohistochemical staining in meningioma. *International Journal of Computational Vision and Robotics*, 11(3), 279–298. http://doi.org//10.1504/IJCVR.2021.115160
11. Razavi, S., Khameneh, F. D., Serteli, E. A., Cayir, S., Cetin, S. B., Hatipoglu, G.,… & Kamasak, M. (2018, June). An automated and accurate methodology to assess ki-67 labeling index of immunohistochemical staining images of breast cancer tissues. In 2018 25th International Conference on Systems, Signals and Image Processing (IWSSIP) (pp. 1–5). IEEE. http://doi.org// 10.1109/IWSSIP.2018.8439184
12. Syrykh, C., Abreu, A., Amara, N., Siegfried, A., Maisongrosse, V., Frenois, F. X.,… & Brousset, P. (2020). Accurate diagnosis of lymphoma on whole-slide histopathology images using deep learning. npj Digital Med. http://doi.org//10.1038/s41746-020-0272-0
13. Oscanoa, J., Doimi, F., Dyer, R., Araujo, J., Pinto, J., & Castaneda, B. (2016, August). Automated segmentation and classification of cell nuclei in immunohistochemical breast cancer images with estrogen receptor marker. In 2016 38th Annual International Conference of the IEEE Engineering in Medicine and Biology Society (EMBC) (pp. 2399–2402). IEEE. http://doi.org//10.1109/EMBC.2016.7591213
14. Berezsky, O. M., Liashchynskyi, P. B., Liashchinskyi, P. B., Sukhovych, A. R., & Dolynyuk, T. M. (2019). Synthesis of biomedical images based on generative adversarial networks. *Ukrainian Journal of Information Technology*, 1(1), 35-40. https://doi.org/10.23939/ujit2019.01.035
15. Berezkyi, O. M., Pitsun, O. Y., & Dubchak, L. O. (2018). Means of artificial intelligence in automated systems microscopy. *Artificial Intelligence*, 2(77), 33-42. Retrieved from: http://jnas.nbuv.gov.ua/article/UJRN-0000999775
16. Berezsky, O. M., et al. (2017). Methods, algorithms and software tools for processing biomedical images. *Economic Thought*, TNEU.
17. Liashchynskyi, P., et al. (2023). Method and software tool for generating artificial databases of biomedical images based on deep neural networks. In CEUR Workshop Proceedings, 3609, 15–26.
18. Berezsky, O., Liashchynskyi, P., Pitsun, O., & Izonin, I. (2024). Synthesis of Convolutional Neural Network architectures for biomedical image classification. *Biomedical Signal Processing and Control*, 95, 106325.
19. Berezsky, O. M., & Liashchynskyi, P. B. (2021). Comparison of generative adversarial networks architectures for biomedical images synthesis. *Applied Aspects of Information Technology*, 4(3), 250-260. https://doi.org/10.1016/j.bspc.2024.106325
20. Yanase, J., & Triantaphyllou, E. (2019). A systematic survey of computer-aided diagnosis in medicine: Past and present developments. *Expert Systems with Applications*, 138, 112876.
21. Demuth, S., Maubon, A., Cotton, F., Armspach, J.-P., & Vian, D. (2024). Clinical applications of deep learning in neuroinflammatory diseases: A scoping review. *Revue Neurologique*. https://doi.org/10.1016/j.neurol.2024.04.004
22. Fang, N., Xu, J., Zhang, H., Cui, S., Jiang, H., Wang, J., Zhang, Y., & Dong, Q. (2024). Computer-aided multiphoton microscopy diagnosis of five different primary architecture subtypes of meningiomas. *Laboratory Investigation*, 100324. https://doi.org/10.1016/j.labinv.2024.100324
23. Brown, M. S., McNitt-Gray, M. F., Yankelevitz, D. F., Henschke, C. I., & Aberle, D. R. (2007). An architecture for computer-aided detection and radiologic measurement of lung nodules in clinical trials. *Cancer Informatics*, 4, 117693510700400. https://doi.org/ 10.1177/117693510700400001
24. Stoitsis, J., Gatzounis, G., Vlachos, N., & Vlachos, P. (2006). Computer aided diagnosis based on medical image processing and artificial intelligence methods. *Nuclear Instruments and Methods in Physics Research Section A: Accelerators, Spectrometers, Detectors and Associated Equipment*, 569(2), 591-595. https://doi.org/10.1016/j.nima.2006.08.134
25. Kim, S. J., Park, E. K., Choi, Y., & Han, M. H. (2010). Comparison of two software versions of a commercially available computer-aided detection (CAD) system for detecting breast cancer. *Acta Radiologica*, 51(5), 482-490. https://doi.org/ 10.3109/02841851003709490
26. Al-antari, M. A., Han, S.-M., & Kim, T.-S. (2017). An automatic computer-aided diagnosis system for breast cancer in digital mammograms via deep belief network. *Journal of Medical and Biological Engineering*, 38(3), 443-456. https://doi.org/10.1007/ s40846-017-0321-6
27. Halalli, B., & Makandar, A. (2018). Computer aided diagnosis-medical image analysis techniques. *In Breast imaging*, 85, 85–109.
28. Naas, M., Ghouali, D., Boughamoura, H., & Abed, K. (2025). Deep learning based computer aided diagnosis (CAD) tool supported by explainable artificial intelligence for breast cancer exploration. *Applied Intelligence*, 55(7).
29. Baker, J. A., Rosen, E. L., Lo, J. Y., & Gimenez, E. I. (2003). Computer-aided detection (CAD) in screening mammography: Sensitivity of commercial CAD systems for detecting architectural distortion. *American Journal of Roentgenology*, 181(4), 1083-1088. https://doi.org/10.2214/ajr.181.4.1811083
30. Oza, P., Sharma, P., & Patel, S. (2022). A drive through computer-aided diagnosis of breast cancer: a comprehensive study of clinical and technical aspects. In Recent Innovations in Computing: Proceedings of ICRIC 2021, 1, 233–249.

О. М. Березький, П. Б. Лящинський
Західноукраїнський національний університет, м. Тернопіль, Україна

ПРОГРАМНА СИСТЕМА АВТОМАТИЧНОГО ДІАГНОСТУВАННЯ РАКУ МОЛОЧНОЇ ЗАЛОЗИ

Надзвичайно актуальна проблема діагностики раку молочної залози, що залишається однією із провідних причин смертності, потребує інноваційних підходів для підвищення точності та оперативності онкологічної діагностики.

У статті обґрунтовано актуальність проблеми створення комплексної програмної системи для автоматичної діагностики раку молочної залози, що є важливим кроком для підвищення точності та ефективності онкологічної діагностики. Запропоновано підхід до розроблення такої системи, що містить модулі сегментації біомедичних зображень, класифікації, ідентифікації інформативних ознак, автоматичної діагностики, синтезу зображень, управління наборами даних, управління моделями нейронних мереж, метриками та управління користувачами. Розроблено функціональні вимоги до програмного забезпечення та спроєктовано його архітектуру відповідно до принципу єдиної відповідальності: кожен модуль виконує чітко визначену функцію, що забезпечує гнучкість, масштабованість та простоту подальшого розширення системи. Реалізацію виконано у вигляді сучасного вебдодатка із використанням технологій Next.js, FastAPI, PyTorch, MongoDB, OpenCV та Mantine UI. Архітектура клієнт-сервер із підтримкою хмарної інфраструктури дає змогу ефективно обробляти великі обсяги медичних даних, забезпечуючи надійність, продуктивність і високу доступність системи. Структура бази даних була розроблена у вигляді логічної UML-діаграми класів, що забезпечує надійне управління інформацією, підтримку операцій CRUD і відповідність вимогам щодо збереження цілісності та конфіденційності медичних даних. Експериментальні дослідження підтвердили ефективність нейронних мереж у завданнях сегментації та класифікації біомедичних зображень, зокрема для ізоляції клітин, оцінювання маркерів та ідентифікації підтипів раку. Результати дослідження мають практичну цінність і можуть бути впроваджені в діяльність медичних установ, а також використані для подальшого розвитку інтелектуальних систем підтримки прийняття рішень у галузі цифрової медицини.

Ключові слова: автоматичне діагностування, нейронні мережі, програмна система, аналіз зображень.

Інформація про авторів:
Лящинський Павло Борисович, аспірант, кафедра комп'ютерної інженерії.
Email: pavlo.liashchynskyi@gmail.com; https://orcid.org/0000-0001-8371-1534
Березький Олег Миколайович, д-р техн. наук, професор, кафедра комп'ютерної інженерії.
Email: olber62@gmail.com; https://orcid.org/0000-0001-9931-4154

Цитування за ДСТУ: Березький О. М., Лящинський П. Б. Програмна система автоматичного діагностування раку молочної залози. *Український журнал інформаційних технологій*. 2025, т. 7, № 2. С. 35-43.
Citation APA: Berezsky, O. M., & Liashchynskyi, P. B. (2025). Software system for automatic diagnosis of breast cancer. *Ukrainian Journal of Information Technolog*y, 7(2), 35-43. https://doi.org/10.23939/ujit2025.02.35