ABSTRACT

of the dissertation by Myrzakerimova Alua Bauyrzhankyzy on «The creation of an automated system for diagnosing diseases of internal organs based on the developed informational mathematical models», submitted for the degree of Doctor of Philosophy (PhD) in the educational program: 6D070300 - «Information Systems»

The relevance of the research topic is due to the need to improve the quality and efficiency of medical diagnostics.

The use of information and mathematical methods makes it possible to create systems capable of analyzing medical data and identifying pathologies with high accuracy. Consequently, these results in the timely identification of illnesses, accelerated diagnostic processes, and enhanced treatment results, all of which are crucial for healthcare and the enhancement of patients' quality of life.

Therefore, the research topic "Creation of an automated system for diagnosing diseases of internal organs, based on developed information and mathematical models" is relevant and promises to make a significant contribution to the development of modern methods of managing business processes using innovative technologies.

The purpose of the dissertation work is to ensure high qualitative and quantitative indicators for diagnosing diseases of internal organs through the use of information and mathematical methods and the application of an automated system for diagnosing diseases.

Objectives of the research. In order to accomplish the objective of the research, a series of interconnected tasks were established and successfully resolved:

- Analysis of existing information and mathematical methods in the field of medical diagnostics and their applicability for creating an automated system for diagnosing diseases of internal organs
- Creation of a space containing informative characteristics, choice of a suitable mathematical research tool
- Create a synthesis approach that establishes clear criteria for categorizing disease symptoms and evaluating their severity
- Modification of fuzzy models for assessing the belonging of disease symptoms to a diagnosis, based on the use of fuzzy inference rules by L. Zadeh and the theory of confidence by E. Shortliffe
- The process of incorporating advanced tools and software into an integrated automated diagnostic system, followed by its evaluation using authentic clinical data

The object of the study is an automated system for diagnosing diseases of internal organs

The subject of the research is information and mathematical methods for diagnosing diseases of internal organs

Research methods - to solve the problems challenges presented in this study, methods of synthesis of medical diagnostic systems, system analysis, system analysis, modeling, the theory of design for complex information systems, the theory of fuzzy sets, applied mathematical statistics, and expert assessment. The Matlab environment, utilizing the Fuzzy logic toolbox package, was employed as a modeling tool in the development of an automated system for diagnosing disorders of internal organs.

Scientific novelty. The dissertation work obtained the following main scientific results:

- Introduces a technique for creating a space of useful characteristics to classify and assess the intensity of diseases symptoms. This method allows for the consideration of the concealed and imprecise nature of the researched category of human functioning states by using a system of measurable features.

- A method has been developed for synthesizing the decisive rules for classifying and assessing the severity of disease symptoms, based on the use of two-dimensional classification methods and symptom sets, which makes it possible to synthesize appropriate mathematical models that work in conditions of poor formalization of the studied symptoms of patient diseases

- The use of fuzzy models for assessing the belonging of disease symptoms to a diagnosis, based on the use of fuzzy inference rules by L. Zadeh and the theory of confidence by E. Shortleaf, has been further developed

Scientific provisions submitted for defense:
- development of a mathematical diagnostic model based on the fuzzy set theory method, considering the fuzzy description of the system's condition
- creation of a model that takes into account not only the degree to which a symptom complex of diseases belongs, but also the state of the system (degree of severity of symptoms)
- application of the developed mathematical model, based on a fuzzy description of the state of the system, for diagnosing diseases and ensuring the reliability of the results

Theoretical and practical significance. The construction of an automated system for identifying disorders of internal organs was based on the development of information and mathematical models, the resolution of fuzzy rules, algorithms, and the related software. The system's experimental operation enables us to

endorse its application in medical practice and for the purpose of educating medical students. The utilization of the instruments suggested in the dissertation study enables the enhancement of the caliber and effectiveness of medical diagnosis pertaining to internal organ diseases, the identification of pathologies, and the reduction of the overall duration required for diagnostic establishment. The system can serve as a supplementary tool in conjunction with fundamental laboratory and instrumental studies.

Approbation of work. The main propositions and scientific results of the work were presented and discussed at seminars of the «Information Systems» department at the International University of Information Technologies and International Conferences:

1. The IIER International Conference, Tashkent, Uzbekistan, 8th-9th September, 2019;
2. 6th International Conference on Engineering and MIS 2020, (IITU), Almaty, Kazakhstan, 14-16 September, 2020. The 6th ICEMIS 2020 is cosponsored by UCLan Cyprus and IARES Inc., Canada. ACM International Conference Proceeding Series;
3. The 11th International Conference on Ambient Systems, Networks and Technologies (ANT) April 6-9, 2020, Warsaw, Poland;
4. 7th International Conference on Digital Technologies in Education, Science and Industry, DTESI 2022 October 20-21, Almaty, Kazakhstan;
5. IEEE International Conference on Smart Information Systems and Techonologies held in Astana, Kazakhstan On May 4-6, 2023
6. 14th International Conference on Emerging Ubiquitous Systems and Pervasive Networks / 13th International Conference on Current and Future Trends of Information and Communication Technologies in Healthcare (EUSPN/ICTH November 2023);
7. IEEE International Conference on Smart Information Systems and Techonologies held in Astana, Kazakhstan On May 15-7, 2024
8. IEEE 4th International Conference on Smart Information Systems and Technologies (SIST), 15-17 May, 2024

Publications: The main results obtained during the dissertation work have been published in fifteen printed works, including 3 articles in publications recommended by the Committee for Control in the Field of Education and Science of the Ministry of Education and Science of the Republic of Kazakhstan, 1 article in Indonesian Journal of Electrical Engineering and Computer Science (Q3) indexed by Scopus in a high-impact scientific journal with cite score 2.9 and a percentile of 43 (Information Systems), and 11 articles in proceedings of international conferences, of which two scientific articles with a percentile of 68.

The results obtained on the topic of the dissertation are presented in the following publications:

1. Myrzakerimova A.B., Nurmaganbetova M.O., Duisebekova K.S., Diagnostic model development based on Mathematical decision-making method with fuzzy Initial data. Proceedings of The IIER International Conference, Tashkent, Uzbekistan, 8th-9th September, 2019. Publisher: IRAJ
2. Myrzakerimova A.B., Duisebekova K.S., Overview of automated systems for diagnosing diseases of Internal organs. KBTU journal september 2019-16 volume, 3. – p. 270-276. ISSN 1998-6688
3. Myrzakerimova A.B., Nurmaganbetova M.O., Duisebekova K.S., Use of mathematical methods for forecasting diseases of internal organs in the proposed automated system. Proceedings of the IV International Scientific and Practical Conference "Informatics and Applied Mathematics", 25-29 september 2019, Секция. Almaty
4. Myrzakerimova A.B., Nurmaganbetova M.O., Duisebekova K.S. Modeling the decision making process for automated system for Diagnosing diseases of internal organs. International scientific journal «Global science and innovations 2019: Central asia» № 2(3). september 2019 ISSN 2664-2271, UDK 004.891.2
5. Myrzakerimova A.B., Nurmaganbetova M.O., Duisebekova K.S., Shaizat M. Forecasting risk of diseases in Kazakhstan with using mapping technique based on 9 years statistics The 11th International Conference on Ambient Systems, Networks and Technologies (ANT) April 6-9, 2020, Warsaw, Poland
6. Myrzakerimova A.B., Nurmaganbetova M.O., Development of an automated expert system for diagnosing diseases of internal organs . Proceedings of the 6th International Conference on Engineering and MIS 2020, (IITU), Almaty, Kazakhstan, 14-16 September, 2020. The 6th ICEMIS 2020 is cosponsored by UCLan Cyprus and IARES Inc., Canada. ACM International Conference Proceeding Series, 2020, 3410759
7. Myrzakerimova A.B., Nurmaganbetova M.O., Applying of the Developed Mathematical Methods and Models for the Diagnosis of Diseases of Internal Organs Using Statistical Data of People of Kazakhstan. 7th International Conference on Digital Technologies in Education, Science and Industry, DTESI 2022 October 20-21, Almaty, Kazakhstan
8. MyrzakerimovaA.B., Kolesnikova K.V., Nurmaganbetova M.O., (2023) development of the structure of an automated system for diagnosing diseases. Scientific Journal of Astana IT University, ISSN (P): 2707-9031 , ISSN (E): 2707-904X,Volume 12, December 2022 DOI: 10.37943/12AVGE4585
9. MyrzakerimovaA.B., Kolesnikova K.V., A mathematical model for an automated system of medical diagnostics. Scientific Journal of Astana IT University. ISSN (P): 2707-9031 ISSN (E): 2707-904X VOLUME 15, SEPTEMBER 2023 DOI: 10.37943/15VKHJ9410
10. K. Kolesnikova, Myrzakerimova A.B., N. Alpysbay, T. Olekh, Transforming Cognitive Maps into Markov Process Models for Software Development Projects. IEEE International Conference on Smart Information

Systems and Techonologies held in Astana, Kazakhstan On May 4-6, 2023 Proceedings, , p 318–321

11. Myrzakerimova A.B., Kolesnikova K.V., Nurmaganbetova M.O., Use of Mathematical Modeling Tools to Support Decision-Making in Medicine. Procedia Computer Science Volume 231, 2024, Pages 335-340 https://doi.org/10.1016/j.procs.2023.12.213

12. Myrzakerimova A.B., Kolesnikova K.V., Khlevna I.L., Nurmaganbetova M.O., Application of mathematical models in the diagnosis of diseases of internal organs. Scientific Journal of Astana IT University, ISSN (P): 2707-9031 ISSN (E): 2707-904X, Volume 17, March 2024, DOI: 10.37943/17ODJA2930

13. Myrzakerimova A.B., Kolesnikova K.V., Development of mathematical methods for diagnosing kidney diseases using fuzzy set tools Indonesian Journal of Electrical Engineering and Computer Science, Vol.35, No.1, July 2024, pp. 405~417. ISSN: 2502-4752, DOI: 10.11591/ijeecs.v35.i1.pp405-417

14. Myrzakerimova A.B., Khikmetov A.K., Kolesnikova K.V., Comparative effectiveness of models and methods for diagnosing diseases of internal organs. IEEE 4th International Conference on Smart Information Systems and Technologies (SIST), 15-17 May, 2024, Astana, Kazakhstan

15. Myrzakerimova A.B., Khikmetov A.K., Khlevna I.L., Automated systems for diagnosing diseases: a review of existing tools. International journal of information and communication technologies, ISSN 2708–2032 (print), ISSN 2708–2040 (online), Vol. 5. Is. 2. Number 18 (2024). Pp. 98–119. https://journal.iitu.edu.kz, https://doi.org/10.54309/IJICT.2024.18.2.009

Main content of the dissertation. This work consists of four main chapters. *The first chapter* analyzes the state of the problems of creating medical information systems and substantiates the relevance of the problem. This part formulates the purpose and objectives of the study. A review of the literature on medical expert systems was also conducted, unresolved aspects were highlighted and the theoretical and practical significance of the study was determined.

Chapter two focuses on models and techniques to diagnosing diseases of internal organs. It explores mathematical models for an automated medical diagnostic system, the idea of fuzzy sets, and methods based on them.

The third chapter focuses on the application of mathematical techniques in the proposed automated system for identifying disorders of internal organs. It specifically emphasizes methods that rely on fuzzy description.

Chapter four provides a comprehensive account of the technological implementation of an automated system designed for the diagnosis of internal organ illnesses. This includes the system architecture, its constituent components,

the methodology employed for its development, and the subsequent construction of the system interface.