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Architecture of an intelligent information system for forecasting components of medical projects

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ABSTRACT

The article concerns the development of an intelligent information system for forecasting components of medical projects. The purpose of the study is to propose an intelligent information system for forecasting component medical projects, which is based on the use of neural network models, as well as statistical and expert methods, which, unlike existing ones, ensures the accuracy of forecasting component medical projects, adaptability to changes in their project environment, as well as accessibility for users. The task of the research is to substantiate the architecture and develop an algorithm for the operation of an intelligent information system for forecasting component medical projects, as well as to develop the user interface of this system and to carry out forecasting of component medical projects. The object of research is decision support processes in medical project management. The subject of the study is the architecture of an intelligent information system for forecasting the components of medical projects, which defines the model, structure, functions, and relationships between its components. The scientific novelty is to substantiate the algorithm and architecture of an intelligent information system for forecasting the components of medical projects based on the use of dynamic data (modern medical records, medical information system server, and other external data), which ensures the formation of a large database underlying the training of neural network models and ensuring high accuracy of forecasting the components of medical projects. The proposed intelligent information system is an effective tool that can be used to increase the accuracy of management decisions and the effectiveness of medical projects. The system involves the use of a medical information system for the formation of a historical database, which ensures the formation of a knowledge base and the development of a set of systematically interconnected blocks. The developed algorithm of the proposed intelligent information system involves the implementation of 17 steps, which reflect the intellectual approach, which involves the use of neural networks for forecasting the components of medical projects. A user interface of an intelligent information system for evaluating component medical projects has been developed, which involves the use of 6 tabs. The use of dialog boxes for forecasting components of 5 groups of projects is foreseen. These include projects for the creation of hospital districts, projects of highly specialized medicine, projects of specialized medicine, projects of primary medicine, and advisory and diagnostic projects. A proposed neural network for predicting the duration of diabetes treatment projects in children. It is a deep neural network with two levels, which provides forecast accuracy at the level of 95.4 %, which indicates its sufficient efficiency and feasibility of use in an intelligent information system. Established trends in the duration of diabetes treatment in children due to changes in the main factors that cause them. The obtained results depend based on improving the quality and accuracy of decision support for assessing the duration of diabetes treatment in children with different states of their disease.

Keywords: Intelligent information system; medical projects; prognostication; algorithm; user interface

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INTRODUCTION

Modern medical projects are complex and resource-intensive, and their success largely depends on many factors [1, 2]. These include sound assessment of resources, effective planning and management, and a clear understanding and quantification of risks. To increase the efficiency and effectiveness of medical projects, as well as reduce the duration of decision-making by managers of medical projects, you should have high-quality instrumentation that allows you to accurately forecast the components of these projects.

Today, many types of information systems are used in medicine to support decision-making [3, 4]. Their design is performed using various approaches and methods (statistical, machine learning, expert, etc.), which provide forecasting of the components of medical projects. Components of medical projects are elements that make up a medical project. They can be physical, such as equipment and personnel, or intangible, such as processes and information.

Statistical methods use historical data to forecast components of medical projects. Machine learning methods use artificial intelligence to learn from historical data, which provides prediction of the components of medical projects. Expert methods use expert knowledge to make predictions. To date, there is no single approach or method for forecasting the components of medical projects, which would be the best for all others under the given conditions [5, 6], [7, 8]. Choosing a forecasting approach and method is a complex task that requires selecting the approach that best meets the specific requirements of the project.

Our paper proposes an intelligent information system for forecasting component medical projects, which combines statistical methods, machine learning methods, and expert methods. The proposed information system is developed based on an architecture that involves the use of artificial neural networks, allowing them to learn from historical data, as well as predict the components of medical projects, and adapt to changes in their project environment. It has several advantages compared to the existing ones, as it involves the use of various methods of forecasting components of medical projects. This information system is more accurate because it uses a combination of forecasting methods. At the same time, it is more adaptable to changes in the project environment, as it can learn from historical data and adapt to changes. The proposed information system is accessible to project managers, as it can be used without the need for specialized knowledge in the field of machine learning.

LITERATURE ANALYSIS

Medical projects are complex organizational and technical systems that are often characterized by uncertainty and risks [9, 10], [11]. To successfully manage such projects, it is necessary to have effective tools for forecasting their components. Such instruments are intelligent information systems (IIS), which belong to powerful tools for forecasting complex systems [12, 13], [14]. They can use various techniques, including statistical techniques, machine learning, and artificial intelligence, to predict the future behavior of a system. The literature presents several studies devoted to the development of IIS for forecasting components of medical projects [15, 16], [17]. These studies have shown that IISs can be effective in predicting these indicators with high accuracy.

The main problems associated with the development of IIS for forecasting component medical projects are:

1) Insufficient amount of data. Sufficient quality data should be available to train the models used in individual IIS modules. However, medical projects are often unique, so it can often be difficult to collect enough data to train intelligent models;

2) Uncertainty and risks. Medical projects are often characterized by uncertainty and risk. This makes it much more difficult to predict the components of such projects in a changing project environment.

The cost of development and implementation. The development and implementation of IIS, due to their complexity and significant development time, leads to a significant increase in the cost of the stages of creating individual modules and, accordingly, leads to an increase in budgets for the creation of IIS [18, 19].

Effective design of IIS for forecasting component medical projects requires a quality selection of forecasting methods. At the same time, several researchers indicate that neural network models (NNM) are a powerful tool for forecasting complex medical projects [20, 21], [22]. They are used to predict a wide range of indicators, such as cost, time of work, resource requirements, quality of services provided, etc.

The literature presents several studies devoted to the use of NNM for forecasting component medical projects. Research by individual authors has shown that NNM can be effective for predicting these indicators with high accuracy [23, 24], [25].

Different types of NNM are used to forecast medical projects. Recurrent neural networks (RNNs) deserve attention. RNNs are well suited for predicting time series, such as resource costs in projects, patient arrivals, etc. [26, 27]. Deconvolutional neural networks (DNN) are used to predict data with a high degree of spatial correlation, such as project execution time, etc. [28, 29]. Deep mixed models (DMM), which are a combination of different types of neural networks, are used to predict the components of the design environment with various properties [30, 31], [32].

When using NNM, factors that affect forecasting accuracy are important.

The accuracy of forecasting using NNM for medical projects depends on the following components:

1) quantity and quality of data for training NNM;

2) characteristics of medical projects and their project environment, such as the complexity of the performed works and their duration;

3) type of NNM used.

Neural network models is a powerful tool for forecasting component medical projects. They can be used to predict a wide range of indicators, including cost, time, and quality of projects. To obtain accurate predictions, it is important to use high-quality data and choose the right type of neural network model.

Further research on the creation of a toolkit for forecasting component medical projects may relate to the following areas:

1) development of new models that will provide a more accurate forecast of component medical projects;

2) development of methods to improve the quality of data used in IIS;

3) development of methods for integration of artificial intelligence tools with other forecasting methods, such as statistical methods.

Based on the performed analysis, it can be argued that further research requires the design of IIS based on an architecture that involves the use of artificial neural networks. This allows the use of innovative models that learn from historical data, and provide accurate forecasting of component medical projects with adaptation to changes in their project environment. Such a toolkit will ensure the satisfaction of the requirements of project managers of medical projects and increase the efficiency of their management.

FORMULATION OF THE PROBLEM

The current state of medical project management is characterized by a number of challenges. In particular, there is a lack of effective tools and methods for forecasting components of medical projects. This leads to suboptimal allocation of resources, increased risks, and inefficient use of resources. There is a need to increase the efficiency of resource management in medical projects. This is important to ensure the provision of quality medical services.

To solve these scientific and applied tasks, we propose the development of a new information system for forecasting the components of medical projects. It will be developed for:

– provision of accurate and timely forecasts of costs for the implementation of projects, assessment of their implementation terms and resource needs;

– identification and minimization of risks associated with medical projects;

– increasing the efficiency of resource allocation in medical projects.

The object of research in the article is the decision-support processes in the management of medical projects. The subject of the study is the architecture of an intelligent information system for forecasting the components of medical projects.

THE PURPOSE AND THE OBJECTIVES OF THE STUDY

The purpose of the work is to propose an intelligent information system for forecasting component medical projects, which is based on the use of neural network models, as well as statistical and expert methods, which, unlike existing ones, ensures the accuracy of forecasting component medical projects, adaptability to changes in their project environment, as well as accessibility for users.

To achieve the goal, it is necessary to solve the following tasks:

– justify the architecture and develop an algorithm for the operation of an intelligent information system for forecasting component medical projects, which are based on the use of an intelligent approach, which involves the use of neural networks for forecasting component medical projects, which ensures the implementation of accurate forecasts during the management of medical projects;

– to develop the user interface of the intelligent information system and to carry out forecasting of the component medical projects, which should be easy to use and intuitive, as well as provide access to all the necessary functions of IIS.

RESEARCH METHODS

The following methods were used in our work to achieve the set goals. In particular, the neural network method [33], or an artificial neural network, which is one of the key components in the development of IIS, was used to predict the components of medical projects. This method is based on the simulation of biological neural networks, and it allows the system to learn from the collected data and use the acquired knowledge to predict future events or outcomes.

Statistical methods – multiple regression and correlation analysis were also used to analyze the components of the project environment that affect the performance indicators of medical projects [34]. Multiple regression makes it possible to analyze the relationships between dependent and independent changes in the components of the project environment. This ensures that medical projects take into account various factors that affect the cost of resources, deadlines, and other indicators. Correlation analysis of the interaction of individual project components and the project environment provides an assessment of the relationship between two or more variables. In medical projects, this can be useful for determining which factors correlate with project performance indicators.

The factor influence analysis method allows us to assess how several independent variables characterizing the project environment affect the dependent variable – indicators of project value. In medical projects, this method evaluates how various project characteristics, such as project type, budget size, team experience, etc., affect the project results - the characteristics of the resulting product and the benefits for stakeholders.

A common framework (MVC – Model-View-Controller) was used to create a prototype of the IIS user interface. This is a way of organizing code that involves separating blocks responsible for solving different tasks. One block is responsible for the application data, another block is responsible for the appearance, and the third block controls the operation of the application. In addition, they performed the general development of interactive interface functions that ensure user interaction with IIS. This includes creating buttons, menus, forms, input fields, and other elements that allow users to interact with the system.

JUSTIFICATION OF THE ARCHITECTURE AND WORKING ALGORITHM OF THE INTELLIGENT INFORMATION SYSTEM FOR FORECASTING COMPONENT MEDICAL PROJECTS

For accelerated and high-quality forecasting of the components of medical projects, we developed IIS, which is based on a neural network model developed by us and published in [35]. The IIS architecture for forecasting component medical projects should provide solutions to the tasks of collecting, analyzing, modeling, and forecasting data related to projects in the medical field. It involves the systematic formation of databases (DB) and knowledge (BZ) from real sources, as well as the use of neural network models to forecast components of medical projects based on them. User interaction with the system is carried out through the developed dialog box. The IIS architecture for forecasting component medical projects is presented in Fig. 1.

The proposed IIS for forecasting components of medical projects includes the following main components:

1) data acquisition sources (medical documentation, medical information system server, and other external data) that provide the formation of a large database that underlies the training of neural network models;

2) a database (DB) has been created, which contains sorted by the required attributes;

3) an intelligent subsystem that provides training, data preparation, and training of neural network models;

4) a formed knowledge base (KB), which involves trained neural network models for forecasting component medical projects and models of relationships between factors that cause their changes;

5) control subsystems of the interface between the user and the computer.

The proposed KB consists of three main components, which will contain knowledge about projects, project environment and neural network models. The project knowledge base contains general knowledge about medical projects, such as types of projects, their stages, resources used, and factors affecting their effectiveness. The knowledge base about the project environment contains knowledge about the specific project environment, which reflects the condition of patients, and the availability of resources for their treatment, and the knowledge base with neural network models is used to predict the components of medical projects.

The intelligent information system uses the information model of knowledge representation – the “semantic network”. This model is a type of graph model used to represent knowledge about a subject area. In our case, the semantic web will be used to represent concepts, relationships, and constraints that apply to medical projects. Neural network

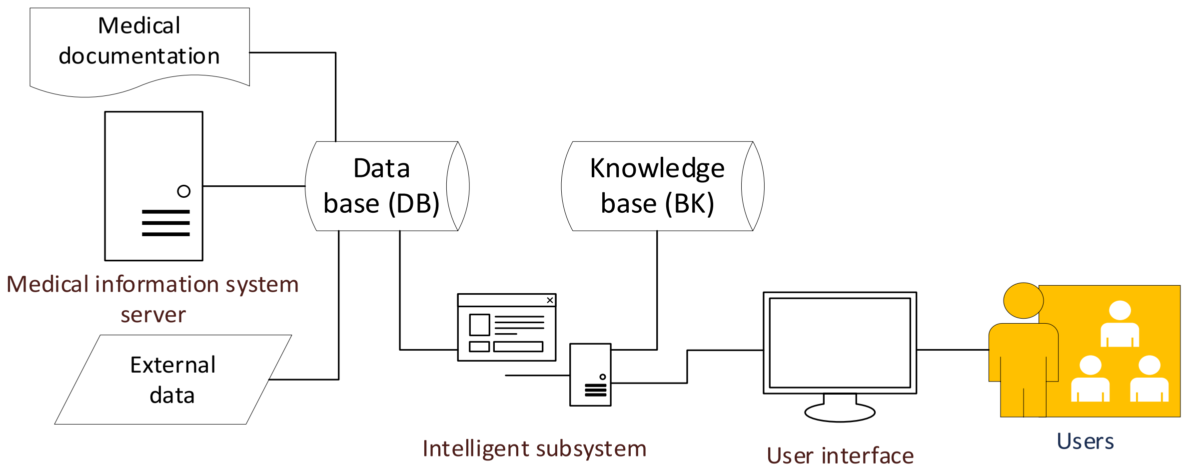

Fig.1. **Architecture of an intelligent information system for forecasting components of medical projects**

***Source*: compiled by the authors**

models will be represented as nodes in a semantic network. Nodes will contain information about the structure, parameters, and training results of the models.

The block diagram of the IIS algorithm for evaluating component medical projects is presented in Fig. 2. This algorithm involves 17 interconnected steps.

The IIS work algorithm for evaluating component medical projects is implemented in the following sequence:

1. Initiate the start of the work of IIS for the evaluation of component medical projects;

2. Obtain from the electronic system of medical records a set of data D on the treatment of diabetes in children, which will be saved in the database;

3. Obtain medical documentation, regulations, restrictions, and rules for forming a database (DB);

4. Create a database of previously implemented projects and patient characteristics using the function $Database\_formation()$ described in the expression:

$$Database\_formation() \Rightarrow D, \qquad (1)$$

where $Database\_formation()$ is a function that performs the database creation operation.

This ensures the execution of an operation with a set of data D about previously implemented projects, which are subsequently stored in the database. The set of data D stored in the database is represented as tuples, where each tuple contains parameter values for a specific type of project and patients and is described by the expression (2):

$$D = \{(P_1, P_2, \ldots, P_n), (P_1, P_2, \ldots, P_m), \ldots\}, \qquad (2)$$

where n, m is number of patients in the database, persons; P_i is characteristic values of each patient, which reflect specific data for each of them.

5. Perform analysis of the database (DB) of previously implemented projects, taking into account the set of characteristics P of the patient's condition, which are described in the expression:

$$P_i = \{p_1, p_2, \ldots, p_k\}, \qquad (3)$$

where $p_1, p_2, \ldots, p_k$ are specific values of patient characteristics; k is number of patient characteristics.

6. Check the condition, and whether there is a need to train the neural network model. If the condition is met, then go to step 7, if not, then go to step 11.

7. Perform data cleaning and preparation for neural network model training. This is done using the data cleanup and preparation function $Data\_cleaning\_preparation(D,R)$ described in the expression:

$$Data\_cleaning\_preparation(D,R) \Rightarrow D_c, \qquad (4)$$

where $Data\_cleaning\_preparation(D,R)$ is data cleaning and preparation function; D is a set of patient treatment data stored in a database; R is the results of previous actions; D_c is the results of previous actions.

As a result of this step, a set of prepared data D_c is obtained for training a neural network model.

8. Conduct training of neural network models. At this step, a search is made for such parameters θ that minimize the error between the model predictions and the true values of the target variables, which can be expressed in the form of a loss function $L(\theta)$, which is described by the expression:

$$L(\theta)=\frac{1}{N}\sum_{i=1}^{N}L\left(y_i,M\left(x_i,\theta\right)\right), \quad (5)$$

where N is number of examples in the training set, units; x_i, y_i are input features and corresponding target values for the i-th example; L is the loss function, which determines the difference between the model's $M\left(x_i,\theta\right)$ prediction and the real value of the duration y_i of treatment of patients.

9. To form a knowledge base (KB), which contains trained neural network models and models of relationships between individual characteristics of the project environment.

10. Enter data about the current status of patients in need of treatment, taking into account the characteristics of the patients described in the expression:

$$P_i=\left\{p_1, p_2,\ldots,p_k\right\}, \quad (6)$$

where $p_1, p_2,\ldots,p_k$ are specific values of patient characteristics; k is number of patient characteristics.

11. Carry out the process of evaluating the components of medical projects $E(t)$ based on the entered data on the condition of patients, using a trained neural network model M .

12. Check the condition and whether there is a need to adjust the data on the current condition of the patient who needs treatment. If the condition is met, then go to step 13, if not, then go to step 14.

13. Adjust data on the condition of patients who need treatment. To do this, the data adjustment function $Data\_adjustment\left(P,E(t)\right)$ is used, which is described by an expression:

$$Data\_adjustment\left(P,E(t)\right)\Rightarrow P', \quad (7)$$

where P' is a vector of adjusted patient characteristics, P are initial characteristics of the patient, $E(t)$ is assessment of component medical projects.

This provides a vector of adjusted patient characteristics.

14. Check the condition of whether there is a need to save the results of the assessment of component medical projects in a file. If the condition is met, then go to step 15, if not, then go to step 16.

15. Save the evaluation results of the component medical projects in a file. For this, the function $Save\_results\left(E(t), File\right)$ described by the expression is used:

$$Save\_results\left(E(t), File\right)\Rightarrow File\_\text{text}, \quad (8)$$

where $Save\_results\left(E(t), File\right)$ is function of saving results; $E(t)$ is assessment of component medical projects; $File\_\text{text}$ is text file with saved results.

This provides a text file $File\_\text{text}$ with saved results.

16. Save and display in the user window the results of evaluation of component medical projects. This process occurs through the execution of the output function $Output\_results\left(E(t), Text, Graph\right)$, which is described by the expression:

$$Output\_results\left(E(t), Text, Graph\right)\Rightarrow \left(Text\_E(t), Graph\_E(t)\right), \quad (9)$$

where $Output\_results\left(E(t), Text, Graph\right)$ is output function; $Text\_E(t)$ is textual description of the obtained results; $Graph\_E(t)$ is schedule for displaying the results of the assessment of component medical projects $E(t)$.

This involves obtaining a textual description $Text\_E(t)$ of the obtained results and graphs $Graph\_E(t)$ for displaying the results of the evaluation of the component medical projects $E(t)$ in the user window.

17. Complete the decision support system for evaluating the duration of treatment of diabetes in children.

The last step involves the completion of the IIS to evaluate the component medical projects.

Based on the algorithm described above, IIS was developed for evaluating component medical projects in Python 3.11, and its user window is presented in Fig. 7.

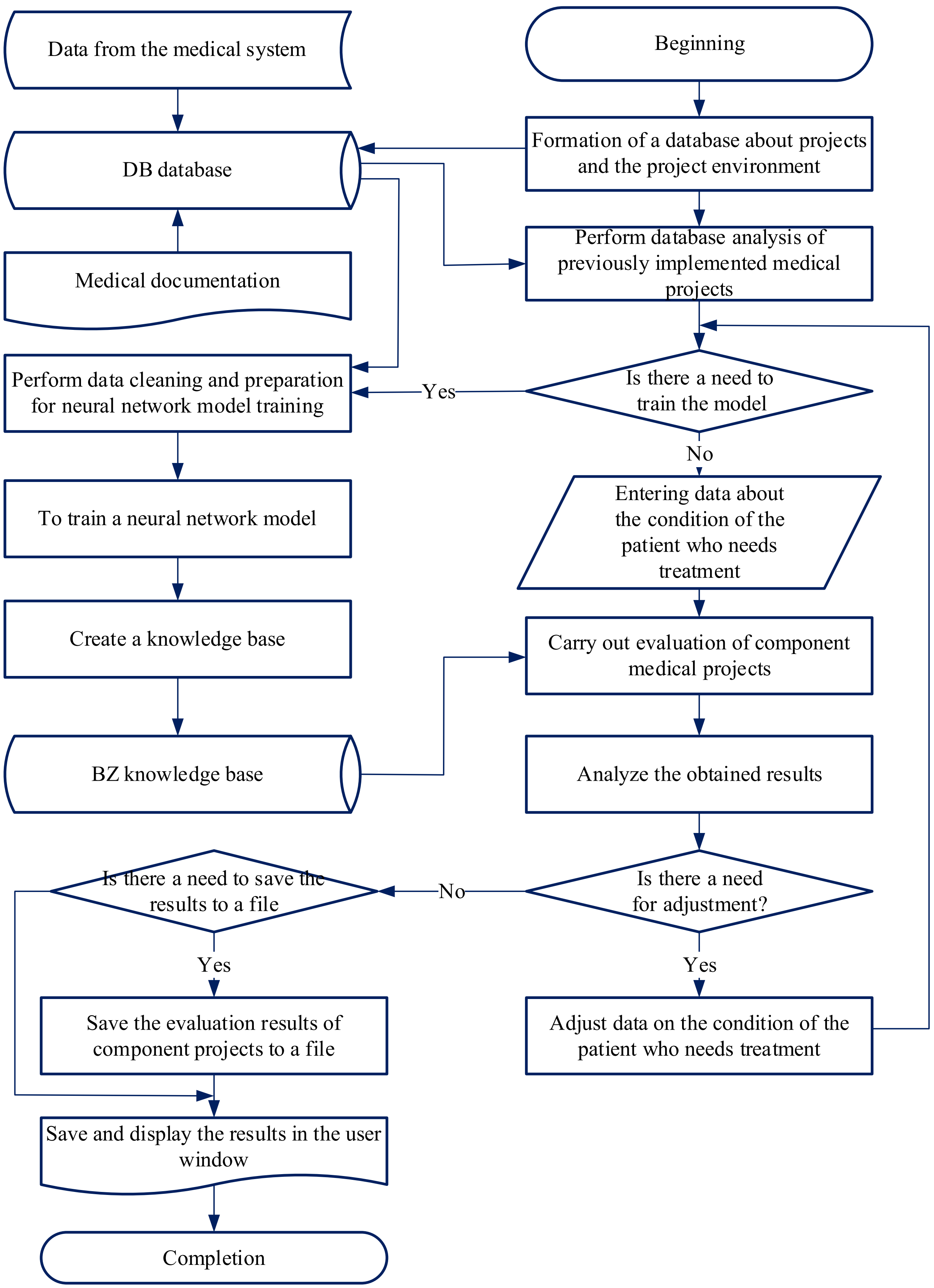

Fig.2. **Block diagram of the algorithm of the intelligent information system for forecasting components of medical projects**

***Source*: compiled by the authors**

DEVELOPMENT OF THE USER INTERFACE OF THE INTELLIGENT INFORMATION SYSTEM AND FORECASTING OF COMPONENT MEDICAL PROJECTS

The user interface is an important component of any information system. IC IIS for evaluating component medical projects should be easy to use and understandable for users (Fig. 3). It should allow users to enter data on a new medical project and receive forecasts from IIS to evaluate component medical projects.

The IIS user interface for evaluating component medical projects has 6 pages. One of them is the starting one – for registration and authorization, and the others contain dialog boxes, respectively, for forecasting component projects of creating hospital districts, projects of highly specialized medicine, projects of specialized medicine, projects of primary medicine, and consultative and diagnostic projects.
The main elements of each of the tabs of the IIS user interface for the evaluation of component medical projects concern the input of the line, the prediction, and the analysis of the performed predictions. Data entry elements provide the ability to enter data about a new medical project. This data should include information about project characteristics such as complexity, duration, and budget. They also include information about project constraints such as cost, lead time, and quality. Elements for forecasting component projects represent the possibility of training neural network models and provide the opportunity to obtain the desired forecasts. Elements of forecast analysis provide an opportunity to gain knowledge about the trends of changes in the components of medical projects due to changes in the project environment. This may include the ability to compare forecasts with actual project results, as well as the ability to track changes in forecasts over time as the project environment changes.

Consider the work of IIS when evaluating the duration of projects for the treatment of diabetes in children. The specified projects belong to the projects of specialized medicine.

Based on the data of the BZ formed from electronic medical records (Electronic Medical Records, EMR), we justified the parameters of the neural network model of direct communication, which was published in [36]. The proposed neural network for predicting the duration of diabetes treatment projects in children is a deep network with two levels (Fig. 4).

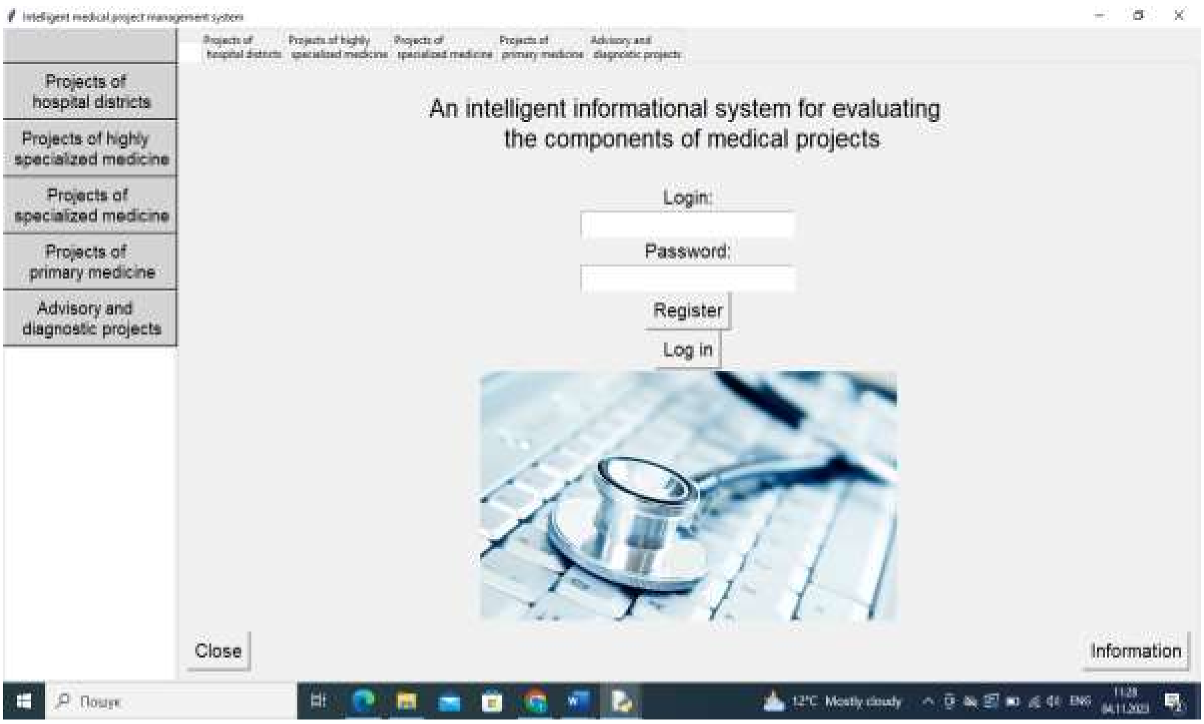

Fig. 3. **The main window of the intelligent information system of medical project management**
***Source*: compiled by the authors**

The first layer has a dense type with 64 neurons and a ReLU activation function. The second layer also has a dense type and 1 neuron used for the regression problem. The total number of model parameters is 385.

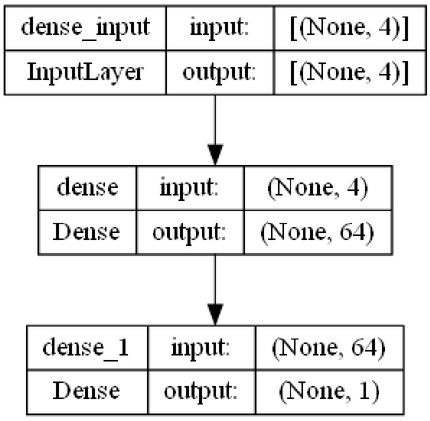

Fig. 4. **The architecture of a forward neural network model for predicting the duration of projects for the treatment of diabetes mellitus in children**
***Source*: compiled by the [36]**

The method of error back propagation was used to train the neural network. This method involves finding such values of the network parameters at which the error between the predicted and actual values of the duration of the treatment projects is minimal. The results of the estimation of the mean squared error (MSE) during the training of the non-network model are presented in Fig. 5. Based on the obtained dependence, it was established that 50 epochs are sufficient for study.

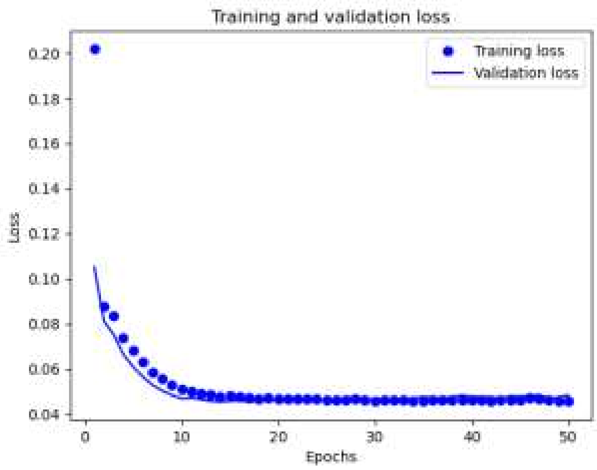

Fig. 5. **Mean squared error (MSE) estimation results during non-network model training**
***Source*: compiled by the [36]**

The trained neural network was used to predict the duration of diabetes treatment projects in children. It can be used for known characteristics of the patient's disease. For example, if we have an 11-year-old child with moderate type 1 diabetes who is taking insulin and metformin, we can use a neural network to predict how long his treatment will take.

Based on the use of IIS to evaluate the components of medical projects, the dependence of the duration of projects for the treatment of diabetes in children on the condition of the patients was established (Fig. 6).

The established dependence of the duration of diabetes treatment projects in children on the condition of patients can be used to improve the quality and accuracy of decision-making support when planning the duration of diabetes treatment projects in children with various states of their disease.

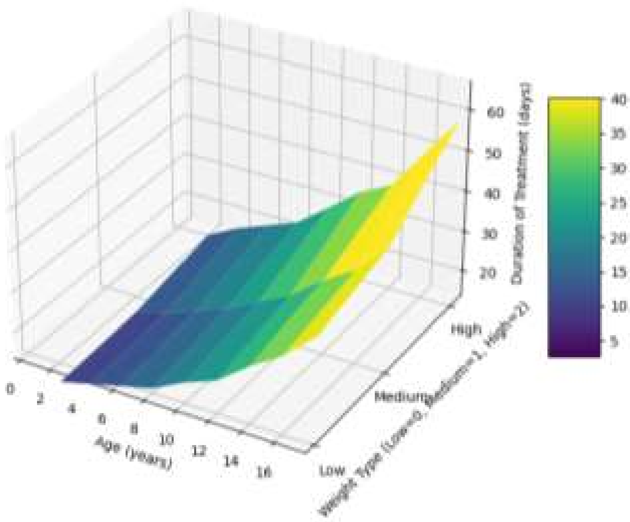

Fig. 6. **Dependence of the duration of diabetes treatment projects in children on the condition of the patients**
***Source*: compiled by the authors**

The developed IIS, which is based on neural network models, provides research and determination of quantitative values of components of medical projects for various characteristics of the project environment. Further research requires the substantiation of the architecture of neural network models and, based on them, the development of modules for forecasting the component projects of creating hospital districts, projects of highly specialized medicine, and primary medicine.

DISCUSSION OF THE RESULTS

We offer an intelligent information system for forecasting component medical projects. It is based on the use of existing medical databases containing sufficiently large samples of historical data, which are subsequently used to forecast individual components of medical projects. This prompted the use of statistical methods, machine learning methods, and expert methods in the proposed intelligent information system for forecasting components of medical projects.

Existing prototype information systems, which are published in scientific works [13, 16], involve the use of traditional methods of data analysis, such as statistics or expert rules, and do not always have flexibility and adaptability, like artificial neural networks. In addition, existing information systems are less accurate, especially in situations where it is difficult to apply specific rules or when there are a significant number of input factors that characterize the design environment. Some prototypes have limited information processing speed or scalability, especially when working with a large amount of data.

The architecture of the proposed intelligent information system for forecasting components of medical projects involves the use of artificial neural networks. It is this toolkit that allows you to learn from historical data and perform forecasts of components of medical projects with adaptation to changes in their changing project environment.

The developed algorithm of the proposed intelligent information system involves the implementation of 17 steps, which reflect the proposed approach to forecasting the components of medical projects. This means that it can be used to predict the duration of treatment for various diseases, as well as to predict other components of medical projects, such as the cost of treatment, the duration of projects, the amount of resources needed, etc. This algorithm is a valuable tool for project managers and healthcare professionals.

The proposed intelligent information system for forecasting component medical projects has several advantages compared to existing ones. In particular, it involves the use of different methods for forecasting component medical projects and their consideration at separate levels that require different methods. The proposed information system is more accurate. It uses a combination of forecasting methods and is adaptive to changes in the project environment because it can learn from historical data and adapt to changes. The proposed information system is accessible to project managers, as it can be used without the need for specialized knowledge in the field of machine learning.

Based on the data of the BZ formed from the current electronic medical documentation (Electronic Medical Records, EMR), we substantiated the parameters of the neural network model of direct communication. The proposed neural network for predicting the duration of pediatric diabetes care projects is a two-layer deep network that achieves a prediction accuracy of 95.4%. This testifies to its sufficient effectiveness and feasibility of use in an intelligent information system for forecasting the components of medical projects.

Based on the obtained results, it can be stated that the proposed intelligent information system, which uses a neural network model of direct communication, is a promising approach to predicting the duration of diabetes treatment projects in children. The system has high prediction accuracy, the ability to learn on large data sets, and is relatively easy to use. These advantages can contribute to the widespread implementation of the system and improve the quality of medical care as a whole.

The use of the proposed intelligent information system in medical projects will increase the accuracy of their planning and speed up the process of making management decisions. In addition, the processes of managing medical projects will improve due to the increase in the accuracy of the performed forecasts. However, at the same time, problems may arise with the formation of a sufficient database regarding the characteristics of previously implemented projects. For this purpose, it is proposed to provide access to the medical information system of Ukraine, which is used by doctors of all levels - the electronic health care system (EHS). It has been operating in Ukraine since 2018. To date, more than 65,000 healthcare institutions are connected to the system, and more than 30 million patients are registered in it.

Our work was limited to individual groups of medical projects. In the future, they can be expanded for each of the proposed groups and, accordingly, develop separate modules for them and offer a toolkit that will ensure the forecasting of the components of these projects. Also, we have only conceptually defined individual components that can be predicted. In the future, they can also be expanded, which requires appropriate research to substantiate an effective toolkit for project managers of medical projects.

CONCLUSIONS

The proposed intelligent information system for forecasting components of medical projects is an effective tool that can be used to increase the accuracy of management decision-making and the effectiveness of medical projects. The system involves the use of a medical information system for the formation of a historical database (DB) regarding the characteristics of implemented individual types of medical projects, which ensures the formation of a knowledge base (KB) and the development of a set of systemically interconnected blocks.

The developed algorithm of the proposed intelligent information system involves the implementation of 17 steps, which reflect the proposed intelligent approach, which involves the use of neural networks for forecasting the components of medical projects.

An IIS user interface for evaluating component medical projects has been developed, which involves the use of 6 tabs. When opening the information system, the user is on the start tab, where he can complete registration and authorization. After that, he can use the dialog boxes to predict the constituents of the 5 project groups. These include projects for the creation of hospital districts, projects of highly specialized medicine, projects of specialized medicine, projects of primary medicine, and advisory and diagnostic projects. The main elements of each of the tabs of the IIS user interface for evaluating component medical projects are related to data entry, prediction, and analysis of performed predictions.

A proposed neural network for predicting the duration of diabetes treatment projects in children. It is a deep neural network model with two levels, which provides forecast accuracy at the level of 95.4%, which indicates its sufficient efficiency and feasibility of use in an intelligent information system. Established trends in the duration of treatment of diabetes in children depend on changes in the main factors that determine them, based on the improvement of the quality and accuracy of decision-making support for the assessment of the duration of treatment of diabetes in children with various conditions of their disease.

Further research, is planned to improve the accuracy and adaptability of the intelligent information system due to the increase in the variety of medical projects, and the justification of accurate models due to the use of more complex methods of machine learning and expert knowledge. The expansion of the types of projects for which the forecasting of their components is proposed necessitates the development of separate modules for them and the selection of effective tools that will ensure the forecasting of the components of these projects.

FUTURE WORK

Further research requires the substantiation of the architecture of neural network models and, based on them, the development of modules for forecasting the component projects of creating hospital districts, projects of highly specialized medicine, and projects of primary medicine.

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Архітектура інтелектуальної інформаційної системи прогнозування складових медичних проектів

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АНОТАЦІЯ

Стаття стосується розробки інтелектуальної інформаційної системи для прогнозування складових медичних проектів. Метою дослідження є запропонувати інтелектуальну інформаційну систему прогнозування складових медичних проектів, яка базується на використанні нейромережевих моделей, а також статистичних та експертних методах, що на відміну існуючих забезпечує точність прогнозування складових медичних проектів, адаптивність до змін у їх проектному середовищі а також доступність для користувачів. Завданням дослідження є обгрунтувати архітектуру та розробити алгоритм роботи інтелектуальної інформаційної системи прогнозування складових медичних проектів, а також виконати розробку інтерфейсу користувачів цієї системи та здійснити прогнозування складових медичних проектів. Запропонована інтелектуальна інформаційна система є ефективним інструментом, який може бути використаний для підвищення точності прийняття управлінських рішень та результативності медичних проектів. Система передбачає використання медичної інформаційної системи для формування бази історичних даних, що забезпечує формування бази знань та розроблення множини системно взаємопов'язаних блоків. Розроблений алгоритм роботи запропонованої інтелектуальної інформаційної системи передбачає виконання 17 кроків, якими відображається інтелектуальних підхід, що передбачає використання нейронних мереж для прогнозування складових медичних проектів. Розроблено інтерфейс користувача IIS для оцінення складових медичних проектів, який передбачає використання 6 вкладок. Предбачено використання діалогових вікон для прогнозування складових 5 груп проектів. До них належать проекти створення госпітальних округів, проекти високоспеціалізованої медицини, проекти спеціалізованої медицини, проекти первинної медицини та консультативно-діагностичних проекти. Запропонована нейронна мережа для прогнозування тривалості проектів лікування цукрового діабету у дітей. Вона являє собою глибинну нейромережу з двома рівнями, яка забезпечує точність прогнозу на рівні 95,4 %, що свідчить про достаню її ефективність та доцільність використання у інтелектуальній інформаційній системі. Встановлені тенденції зміни тривалості лікування цукрового діабету у дітей від зміни головних чинників, які їх зумовлюють. Отримані результати залежать в основі підвищення якості та точності підтримки прийняття рішень для оцінення тривалості лікування цукрового діабету у дітей із різними станами їх захворювання.

Ключові слова: інтелектуальна інформаційна система; медичні проекти; прогнозування; алгоритм; інтерфейс користувача.

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