Потужність серцевого м’язу визначається за співвідношенням

$$W = ABS(KDO_i - KDO_{i-1}) * H \max / 0.02.$$

За результатами обчислень виконується процес класифікації стану пацієнта в автоматичному режимі з використанням штучних нейронних мереж.

Отримані результати є похідними для визначення діагнозу.

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# RELATION DATALOGIC MODEL FOR DETERMINING THE DIAGNOSIS BASED ON INTELLECTUAL NLP-ANALYSIS OF SYMPTOM DESCRIPTION

**Mazurets Oleksandr**
Ph.D (Engineering Science), Associate Professor
exe.chong@gmail.com
**Sobko Olena**
Teacher
olenasobko.ua@gmail.com
**Klimenko Valeriia**
Teacher
ler.klimenko.8@gmail.com
**Kozenko Yuliia**
Postgraduate student
yulkozenko13@gmail.com
Computer Science Department
Khmelnytskyi National University, Ukraine

The diagnosis determination based on the textual description of symptoms using natural language processing (NLP) methods involves the potential creation of effective tools for automated or supportive medical diagnostics [1].

Artificial intelligence programs capable of analyzing textual symptom descriptions can expedite the diagnostic process, especially in cases where swift response can save a patient's life [2]. Utilizing machine learning algorithms based on NLP can help sift through and consider a wide range of possible diagnoses, providing more accurate results, particularly in complex clinical cases [3].

In addition, the increasing amount of medical data creates a need for efficient tools for their analysis. The use of NLP enables the automation of text analysis

processes, helping separate important data from noise and ensuring a more comprehensive analysis.

Disease diagnosis is a crucial part of medical treatment as it allows the physician to develop a treatment plan that is most effective for a specific patient. Traditional diagnostics include gathering medical history, physical examination, and conducting diagnostic tests [4]. However, these methods can be labor-intensive, expensive, and may not be readily available in remote areas. With the development of telemedicine and the use of chatbots or messengers as a means for remote consultations, healthcare becomes more accessible for everyone [5]. Therefore, diagnosing diseases based on the textual description of symptoms using NLP has the potential to improve the accessibility and efficiency of medical care and requires automation.

The objective of the work is to design a relational database model for the automated determination of diagnoses based on textual descriptions of symptoms using natural language processing (NLP) tools, along with the corresponding software in the form of a desktop application.

A key component of any information system is a properly structured database that reflects and stores the necessary information for its optimal functioning. The creation of a database grounded in the method of diagnosing conditions based on textual symptom descriptions using NLP tools is a crucial step in the design process. Figure 1 illustrates the database model of the information system, which is based on the method of diagnosing conditions based on textual symptom descriptions using NLP tools.

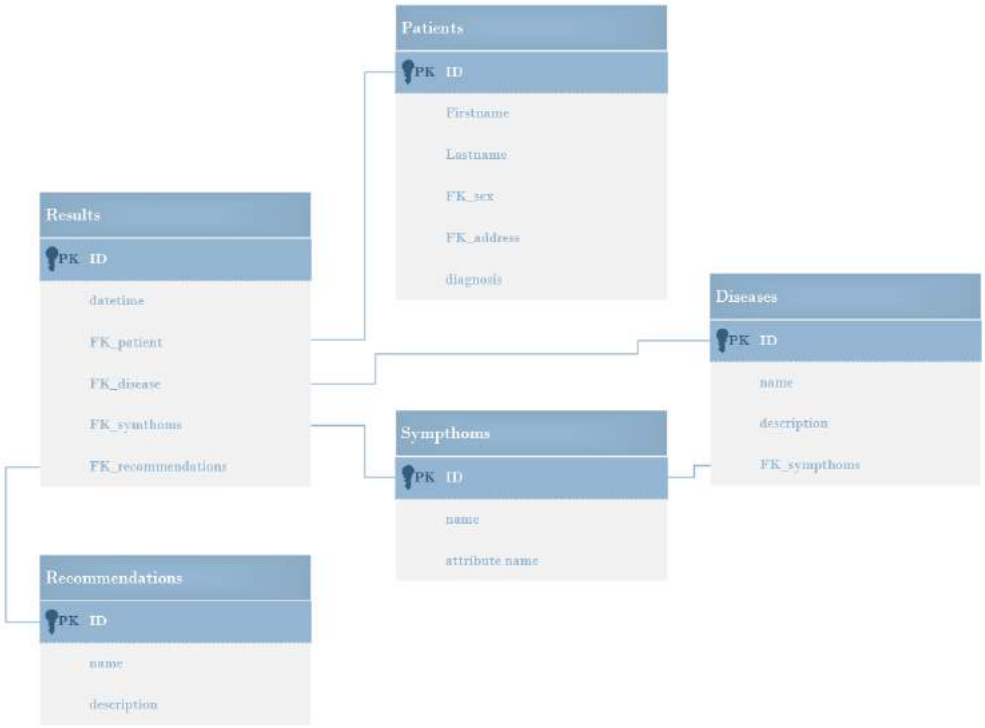


Figure 1. Data model of the database based on the method of diagnosing conditions using textual symptom descriptions.

The creation of the database structure in accordance with the requirements of the information system ensures efficient storage, organization, and quick access to data, which is crucial for the proper functioning of the system.

The table “Patients” will store patient data, specifically containing fields for the last name and first name, gender, residential address, and the diagnosed condition of the patient. The table “Patients” has the following attributes:

– ID (int) – primary key. This attribute serves as a unique identifier for each patient within the database. It ensures that each patient record has a distinct identification number.

– FirstName (varchar(255)) – first name of the patient. This attribute stores the given name of the patient, allowing for individual identification within the system.

– LastName (varchar(255)) – last name of the patient. This attribute captures the family name or surname of the patient, contributing to the complete identification of an individual.

– FK_sex (int) – foreign key referencing the “Sex” table. This attribute establishes a link to a corresponding record in the "Sex" table, providing information about the gender of the patient.

– FK_address (int) – foreign key referencing the “Address” table. This attribute creates a connection to a corresponding record in the "Address" table, associating the patient with their place of residence.

– diagnosis (Varchar(255)) – diagnosis of the patient. This attribute stores the name of the diagnosed medical condition for the respective patient. It plays a crucial role in organizing and categorizing patient information within the database.

The table “Results” is designed to store the date and time of examination results, information about patients, a list of existing diagnoses, symptoms, and treatment recommendations. This table has the following attributes:

– ID (int) – primary key. A unique identifier for each research result within the database. Provides a distinct number for each record of the research result.

– datetime (datetime) – date and time of recording the research results. This attribute indicates the exact time when the research results were registered.

– FK_patient (int) – foreign key referencing the “Patients” table. This attribute establishes a link to the corresponding record in the “Patients” table, associating the research result with a specific patient.

– FK_disease (int) – foreign key referencing the “Diseases” table. This attribute creates a connection to the corresponding record in the "Diseases" table, specifying the diagnosis associated with the research result.

– FK_symptoms (int) – foreign key referencing the “Symptoms” table. This attribute establishes a link to the corresponding record in the "Symptoms" table, indicating the symptoms associated with the research result.

– FK_recommendations (int) – foreign key referencing the “Recommendations” table. This attribute creates a connection to the corresponding record in the “Recommendations” table, specifying the treatment recommendations associated with the research result of the patient.

The table “Diseases” is designed to store information about illnesses that can be diagnosed during examinations. The table includes fields for recording the name of the disease, the causes of the illness, and its symptoms. This table has the following attributes:

– ID (int) – primary key. A unique identifier for each disease within the database.

– name (varchar(255)) – the name of the disease. This attribute stores the name or title of the disease.

– description (varchar(255)) – description of the disease. This attribute contains a brief description or information about the disease.

– FK_symptoms (int) – foreign key referencing the “Symptoms” table. This attribute establishes a link to the corresponding record in the “Symptoms” table, associating the symptoms that are characteristic of the disease.

The “Symptoms” table is designed to store the names of symptoms that are characteristic of various diseases. This table has the following attributes:

– ID (int) – primary key. This attribute serves as a primary key, providing a unique identifier for each symptom. It ensures that each symptom has a distinct identification number within the database.

– name (varchar(255)) – the name of the symptom is stored in this attribute. It captures the specific title or label associated with each symptom.

The “Recommendations” table contains information about treatment recommendations for a diagnosed patient's specific disease. This table has the following attributes:

– ID (int) – primary key. This attribute acts as a primary key, ensuring a unique identifier for each recommendation. It provides a distinct identification number for each record within the “Recommendations” table.

– name (varchar(255)) – the recommendation's name is stored here, representing the specific title or label associated with the treatment recommendation.

– description (varchar(255)) – this attribute provides a brief description or additional information about the treatment recommendation.

The “Sexes” table contains information about gender names. This table has the following attributes:

– ID (int) – primary key. This attribute serves as a primary key, providing a unique identifier for each gender name. It ensures that each gender has a distinct identification number within the database.

– name (varchar(255)) – the gender name is stored in this attribute, capturing the specific title or label associated with each gender.

So, the diagnostic information system based on text descriptions consists of three subsystems and a database. The database for the disease diagnostic system is intended to store data on diseases and recommendations for their treatment.

The database subsystem's main purpose is to interact with the database. This subsystem functions to view, edit, delete, and add new texts with disease descriptions, as well as view, edit, delete, and add new treatment recommendations for diseases.

The diagnostic subsystem is the main subsystem, designed for direct disease diagnosis based on user text descriptions. Its functions include entering the text description of a disease, determining the probable disease from the description, and determining treatment and prevention recommendations for the classified disease.

The diagnostic subsystems interact with the preprocessing text data subsystem, which is designed to clean the user's input text from stop words and stop symbols and transform the text description of the patient's condition into vector representation.

To obtain the result, the user needs to enter a textual description of their condition in the first text field, for example, “Я сильно схуднув за останній тиждень, тому що не міг багато їсти через нудоту. До цього додалася висока температура, головний біль і біль у шлунку”. After clicking the “Diagnose” button, the result will be displayed in the second text field, labeled “Result”. In addition to the probable diagnosis, information about treatment recommendations will also be displayed in the text field below (Figure 2).

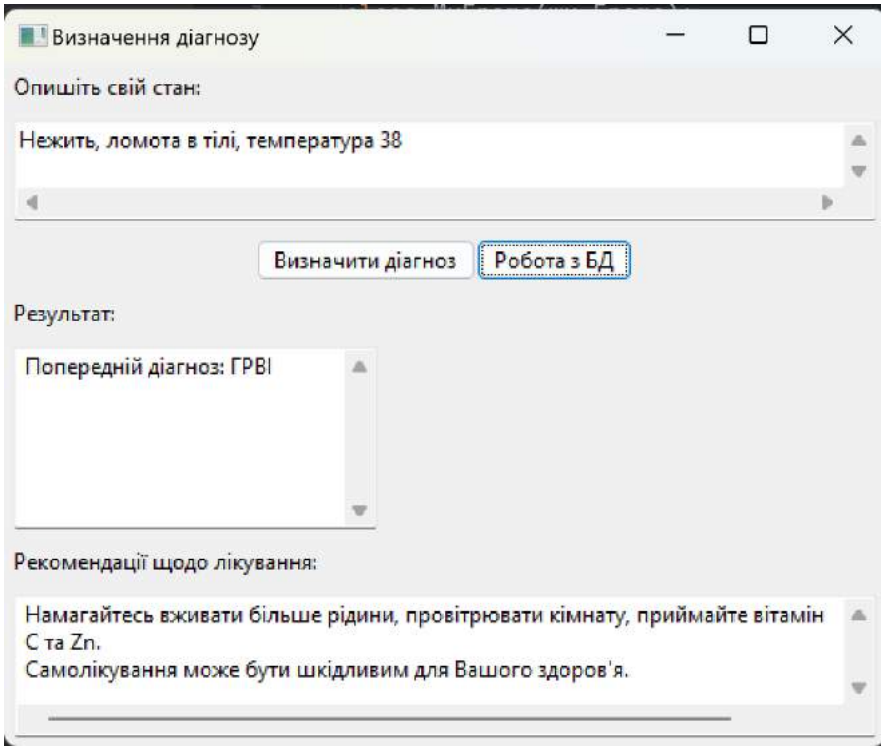


Figure 2. The result of the program code execution.

The k-nearest neighbors (KNN) method was chosen to determine the diagnosis, which is a simple and effective machine learning algorithm for classification and regression. This algorithm uses the idea that objects that are close to each other in the feature space have similar labels. To check the results of the method that will determine the probable diagnosis based on the description of the symptoms, the report function was created. This is a function used to generate a report on classification results. The report displays the main classification evaluation metrics, such as accuracy and classification report. Using the accuracy_score function from the scikit-learn library, the accuracy is calculated, and the classification_report function from the scikit-learn library generates and outputs a detailed report of the classification performed, namely the accuracy, loss function and F1-score for each class, as well as the summary values for all classes Accuracy values obtained as a result of method verification on a test sample of data are 0.97.

Therefore, a relational data model for a database was designed for the automated determination of a diagnosis based on textual descriptions of symptoms using NLP

tools, along with corresponding software in the form of a desktop application. By utilizing an SQLite database, reliable storage and organization of medical information can be ensured. This enables high-speed data access and efficient processing of user queries. All of this together forms a robust foundation for creating a useful application that can significantly streamline the diagnosis determination process in medical practice and enhance the quality of healthcare services.

Additionally, a software application was implemented to determine a diagnosis based on textual descriptions of symptoms using NLP tools, utilizing the developed relational data model for the database. The created software product includes functions for determining the probable diagnosis and text description, entering new information, and working with the dataset. The functional structure of the information system for diagnosing diseases based on textual descriptions was described, consisting of three subsystems: working with the database, diagnosis, preprocessing of text data, and the corresponding database.

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# ВИКОРИСТАННЯ ШТУЧНОГО ІНТЕЛЕКТУ В ОФІСНИХ СИСТЕМАХ

**Немченко Володимир Петрович**
канд. техн. наук, доцент, професор
volodymyr.nemchenko@nure.ua
Кафедра автоматизації проектування обчислювальної техніки
Харківський національний університет радіоелектроніки, Україна

Повсюдна інформатизація сьогодні є характерною рисою нашого суспільства. Це призводить до того, що певна частина працездатного населення країни працює у великих, малих чи навіть у домашніх офісах (Small Office -