ABSTRACT

Relevance of the topic Ensuring proper technical condition of the civil defense protective structures becomes of crucial importance in wartime in Ukraine. The negligence poses a great threat to human life and health. At the time of writing of this thesis, regular massive attacks on Ukraine's energy and civil infrastructures are underway. It may cause destruction of the structures and leads to rapid increase in the number of shelters and protective structures requiring regular monitoring to be performed. It is proved that multiple violations, manifested as poor condition of the civil defense protective structures, are quite often revealed during the inspections of the civil defense protective structures in Ukraine. It is partially caused by poor efficiency of the standard manual control. In order to correct this, automated monitoring which can detect dangerous changes in the building structures more promptly, should be paid attention to. Though, the challenge of processing of large volumes of data generated as the result of this monitoring can arise. This issue can be solved by applying the intellectual approaches for the risk assessment based on the artificial intellect, which can not only solve the problem of processing of large volumes of data, but also predict the building structures condition based on these data, in the near and distant future. And even today, the tools using artificial intelligence are called assistants for the experienced engineers. This is because they can provide a quick assessment of the parameters of the structures condition. And this is just the beginning of the development of the industry. Thus, development of these intelligent analysis systems is relevant and timely.

Goal of the research The goal of the thesis is development and introduction of the improved approach for the analysis of the protective structures condition. The work is based on the developed computer system analyzing the condition of the civil defense structures, but it will be supplemented by the intelligent analysis module. This module is to predict technical condition of the civil defense protective structures and work on identifying and preventing potential risks in building structures. The integration includes development of the decision support tool for the engineers to increase rapidity of the assessment and the accuracy of the risk rating.

Object of the research - artificial intelligence methods and the way they are to be integrated with the existing system

Subject of the research - specified intelligent methods for the data analysis in the systems monitoring building structures condition for the civil defense shelters

Scientific novelty of the research

Introduction made - the idea to combine through close integration machine learning and the existing system monitoring building structures condition developed before on the basis of the web framework Django, a free and open-source relational database management system (RDBMS) PostgreSQL, as well as Telegram-bot for the intelligent processing of the data about the technical condition of the structures analyzed in the system before.

Development made - a model for assessment of the technical condition of the protective structures based on the analysis of the historical data about building structures operation. The model allows predicting the tendencies towards building structures condition changes and identifying the respective abnormal deviations.

Implementation made - the early-warning algorithm about falling the building in poor condition

Practical value of the thesis is development of the software allowing analyzing the data about condition of the civil defense protective structures and predicting deterioration of the building structures before they fall in totally poor condition. This tool is possible to be integrated with the existing systems monitoring condition of the civil defense protective structures. This development has already been integrated with the one of the systems mentioned above, increasing accuracy and reliability of the assessment of the structures condition for this system, as well as reduced the response time for the services operating this system.

Approbation of the results Intermediate conclusions and results of the research have been discussed and taken into account during the following conferences:

1. IX All-Ukrainian student scientific conference “EXPERIMENTAL AND THEORETICAL RESEARCH IN MODERN SCIENCE”

2. XVIII Scientific and practical graduate and postgraduate students conference. Faculty of Applied Mathematics and Computing, AMC - 2025.

List of publications:

1. Server-side design principles for processing client application reports// IX All-Ukrainian student scientific conference “EXPERIMENTAL AND THEORETICAL RESEARCH IN MODERN SCIENCE”. By Ustymenko I.V.: 2025, p.94-96

2. Designing a large-scale and fault tolerant server-side system for report collection//XVIII Scientific and practical graduate and postgraduate students conference. Faculty of Applied Mathematics and Computing, AMC - 2025. - p. 295-298.By Ustymenko I.V.

Structure and length of the thesis shall comply with the strictly defined requirements for research papers. This Master’s thesis complies with the requirements for the structure, length and other ones defined for research papers. The thesis includes an introduction, four chapters and a conclusion.

The introduction justifies the relevance of the chosen topic, defines the object of the research and essence of the issue to be improved in practice. It specifies the goal of the research. This chapter describes scientific novelty and the benefits to be brought by the software improvement in details.

The first chapter provides an overview of the existing modern systems monitoring the technical condition of the civil defense protective structures. This overview concludes division of all existing systems into certain groups. It focuses on all current assessment methods for civil defense protective structures to provide better understanding of the software developed. It presents the analysis of all current tendencies for using the artificial intelligence in the civil defense protective structures. The chapter also includes the analysis of the issues caused by these systems and the ways to solve them. In addition, it pays attention to geographic information systems as a part of the current systems for analysis of the civil defense protective structures.

The second chapter explores the architecture of computer systems for data analysis. It defines the role of the machine learning in the system. It provides the analysis of the regression and classification algorithms to be used in technical monitoring.

The third chapter explores the architecture of the existing system for the analysis of the civil defense protective structures and examines the possibility for the analytical module to be integrated with this system. The chapter describes the algorithm used for assessment of the structures technical condition and presents a general description of the analytical module.

The fourth chapter contains testing of the system developed. Moreover, it lists recommendations on further improvements.

The conclusion presents the analysis of the compliance of the work performed with the requirements set to it. In addition, it summarizes the respective findings.

The Master's thesis is 118 pages in length. It includes 4 chapters, 1 figure, 7 tables and references.

Key words: analysis system; civil defense protective structures; machine learning; Django; Telegram Bot; PostgreSQL; intelligent systems.