Development of the structure and creation of a database of the Geological Museum of the Taras Shevchenko National University of Kyiv

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SUMMARY

This article presents a comprehensive study on the development of a geological museum database at the Kyiv National University, aimed at digitizing and managing information about mineral exhibits. As the global geological data registration continues to increase, digitalization becomes crucial for efficient data management. The paper outlines a systematic approach, including website development, data storage methodologies, and automation tools. The chosen "Materialized Path" algorithm for structured data storage in relational databases and the JSON approach in MongoDB are highlighted for their efficiency. The integration of Flask framework, Python programming, and Telegram application supports the creation of a user-friendly website and tools. The results showcase the successful implementation of the database, which enables staff to manage and update exhibit details, news, and event information. The paper underscores the potential for wider accessibility, collaboration, and preservation of geological data, contributing to the advancement of earth sciences. Despite resource limitations, this project signifies a pivotal step in digitalizing geological museums and promoting geological heritage understanding.

Keywords: data collection, database, website, geodatabase
Introduction

In geology, descriptive datasets of minerals are important sources of information for understanding the Earth and studying both local and global geological and geodynamic history. Effective collection, aggregation, and dissemination of this type of data is essential to performing rapid and accurate research. Every year, the number of registered geological data at the global level is increasing. (Gard et al., 2019)

While world is digitalizing technologies are rapidly gaining momentum, digitalization is becoming a necessary stage for effective management of geological data. In Ukraine, there is an active development of databases in geology, especially in geological museums where unique samples are kept. (Dynyak et al., 2013)

The development of the database of the geological museum of the Kyiv National University is an important step for access to scientific data and support for research in the field of geology. Digitization will help optimize museum management and improve research and teaching opportunities. The implementation of the project is of great scientific and practical interest and reflects the integration of modern technologies into scientific activity.

Method and Theory

A website development plan was defined, which would contain the following static and dynamic information: a museum history page, news, a list of museum exhibits, a gallery, and information about expert services

The problem of any complexity in the information industry can be solved thanks to the implementation of a scientific approach. (Bougie et al., 2019). The main components will be: infrastructure (modern means of computing, storage and communication channels), tools for working with exhibits and their digital displays, and the methodology of collecting and processing information. This will enable efficient digitization of many exhibits and prepare solutions for future development, including augmented reality capabilities for interactive student learning.

Among the existing algorithms for storing structured tree data structures in relational databases, "Materialized Path" was chosen as one that is effective enough to solve the problem of digitizing and storing information about the exhibits of the Geological Museum (Zhu, 2017).

In this work, the JSON approach in the MongoDB database (Fig. 1) was chosen to store data on museum exhibits because of its efficiency. (Zidianakis et al., 2021). Unique identifiers of exhibits are used in the form of Universally Unique IDentifier (UUID) to ensure the uniqueness and possibility of creating QR-Code labels. To implement the website, Flask was used as a simple and effective web framework in the Python programming language. The Telegram application with a set of functions for key infrastructure elements is also used.

The following tools are planned to be created to automate the processes of digitizing and storing information about the Geological Museum's exhibits:

- Telegram Chatbot is a personal handheld tool for museum staff that will allow them to work with exhibits and conduct primary data collection in halls and storage facilities.

- The Geological Museum website is a tool for adding and editing information about exhibits. It is in test mode.

- A tool for creating labels for exhibits in MS Word format with label templates. Allows you to standardize labels for printing and placing on the appropriate objects.
The project is focused on the development of a technical solution and does not include the creation of a unique web design. To create the website, the Flask framework was used, which combines back-end solutions written in Python and the front-end part created in HTML (Jeovano, 2020).

Results

In the process of collecting and processing data on the exhibits of the Geological Museum, the developed database project is used, which was systematically developed and tested during development and testing.

The website, which was also created, allows responsible employees to enter full detailed information about exhibits. In addition, the website regularly updates dynamic information such as news, information about exhibitions and conferences.

All these actions and operations are carried out systematically and organized according to the following algorithms, which are given in the PlantUML format (Fig. 2)
In addition, it is possible to interact with existing records in the database or create new ones directly using the PostgreSQL language or using the MongoDB database editor (Fig. 3).

![Figure 3](image1)

**Figure 3** Implementation of interaction with the database directly using PostgreSQL (a) and via MongoDB (b)

During the development, the interaction between the main components of the system was realized, and communication channels between different servers were established. The entire technical implementation of the project was carried out using only free open resources and web hosts. (Fig. 4)

Some limitations of free platforms did not allow expanding the functionality, in particular, mechanisms for authorizing users on the website and creating separate roles for them with appropriate access rights.

The launch of the developed database of the Geological Museum of Taras Shevchenko National University of Kyiv can be the first step towards the research and preservation of unique geological data, as well as the expansion of cooperation between geological museums and scientific institutions in Ukraine and abroad.
Conclusions

In this research paper, a thorough analysis was conducted and a database structure was developed for the Geological Museum of Taras Shevchenko National University of Kyiv. The aim of the work was to create a digital archive containing information about preserved samples of minerals, rocks, fossils and other geological finds, providing access to valuable scientific data and supporting further research in the field of geology.

The project envisages the creation of a database structure that will allow storing information on various types of geological finds and efficiently processing them. This will allow the museum to become accessible to a wide range of users, including scientists, students, and the general public, which will help popularize geology and increase interest in the study of earth sciences.

This development reflects attempts to optimize and expand the functionality of the system using limited resources, but at the same time provides an opportunity to further improve its level of efficiency and expand its capabilities in the event of additional resources, the possibilities for further development of the project are unlimited.

The project can become an important step in the digitalization of geological museums in Ukraine and contribute to the preservation and study of the rich geological heritage of our country.

References


