The Development of myGeo-RS: a Knowledge Management System of Geodiversity Data for Tourism Industries

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Abstract

The development of MyGeo-RS, a geodiversity information and repository system is a valuable solution that can assure the management and preservation of geological datasets more interesting, accessible and shared to the public at large. This research is embarked based on the realization that with the advancement of information and communication technology, as well as data mining and knowledge discovery, knowledge about geodiversity can be better represented and explored. This project attempts to establish on how geodiversity components and their relationships can be modeled into various forms of digital object (DO) to enable access and sharing of geodiversity information. The target user groups of this project are mainly to public users and tourism industry. This paper presents the research objectives, research approach, system analysis and myGeo-RS architecture.

Keywords: geodiversity, digital object model, MyGeo architecture, Langkawi geoheritage

1. Introduction

All geological and landscape resources have two opposing value sets: extractive and conservative activities [1]. In the conservative concept, a new paradigm earth physical resource is regarded as having value in the context of knowledge, history and culture. The geoconservation idea arose mainly from the need to protect heritage resources that were already recognized by the general public (or naturalists and geologists) in the context of preserving the landscape beauty for recreation or outstanding heritage value. The philosophy is embodied in the UNESCO's Geopark approach, which provides guidelines for identifying, and assessing natural world heritage sites that have outstanding universal value [2]. A Geopark is defined as an area with a geological heritage of significance, with a coherent and strong management structure and where a sustainable economic development strategy is in place [3]. Geoparks are not just about rocks but they are also concerned with people.

The foundation of the assessment of geological heritage resources is geological diversity or geodiversity. The concept of geodiversity is a new concept amongst geologist that carries a different meaning to different researchers [1]. It refers to the range of geological (bedrock), geomorphological (landform) and soil features, assemblages, systems and processes. The geodiversity concept takes into account the different dimensions shown by a geological exposure or landform. In addition to the variety of characteristic of minerals, rock, fossils, structure and landform features; time, environment and processes are also incorporated in dealing with geodiversity. It contributes to our quality of life in many ways. Its benefits include, Appreciation, Knowledge, Products and Natural Processes [2].

Geoheritage value is strongly linked with the specific geodiversity pertaining to significant scientific records for research, education, tourism and industry usability. This diversity includes a varied and complex amount of information and data concerning rock, mineral, fossil, structural and landform diversity that can be found in varied forms and resources.

Similar to the necessity and success that derived biologist to represent and deploy their information digitally into biodiversity information systems, the geologist as well have been attracted to this technology according to the nature of the complexity and diversity of geological datasets and their interrelated components. Therefore, providing theoretical and systematic modeling approaches for organizing and representing those datasets to global access have become one of the arising challenge that required more attention from the researchers and computer professionals in Malaysia. This need has been derived from scientific, educational, research, industrial, economic, social, culture and inspirational values that can be gained. In addition, the lack of awareness from the software professionals to the geodiversity domain remains

hidden from the global sharing. Moreover, the preservation of geodiversity datasets is semi or unorganized, as well as the overlook of digital archiving aims is another issue to be considered.

Information system through various research works has been proved to be an appropriate solution to facilitate the organization and archiving of varied and complex information concerned different domains as biodiversity, medical and environment [4]. Therefore, the development of geodiversity information or repository system is believed to be one of the suitable solutions that can assure the management and preservation of geological datasets to be more interesting, accessible and shared to the public at large. Probably, with the advancement of information and communication technology, as well as data mining and knowledge discovery, knowledge about geodiversity can be better represented and explored. This project attempts to establish on how geodiversity components and their relationships can be modeled into various forms of digital object (DO). These sets of digital objects can then be incorporated into primary repository of Geodiversity Repository System (GRS) for easy manipulation of DO's information and knowledge.

In this project an exclusive geodiversity information system will be developed that focuses on creating a new digital object model, namely Networked Digital Object (NDO). This model allows a sharing environment with a knowledge discovery through relating varied and specific DOs among the geodiversity components to produce a new NDO, which represent new information. Together with the input from Langkawi Geopark components and knowledge, GRS can be customized into Langkawi Geopark GRS (LGGRS). With this establishment, further research on geological data and expertise and other DO services can be incorporated into the repository. Finally, GRS can be generalized to offer geodiversity knowledge for other places. Bringing GRS technology closer to knowledge based, knowledge management and data mining several models can be proposed for both commercial products and research prototypes.

2.. Literature Review

For the past decade, organizations, universities and research units from different areas which include fields such as biology, medicine, chemistry and geology have witnessed an exponential growth in digital information available for learning and sharing experiences. There are many collections of digital objects including images, texts, audios, and videos that have great value in a diverse set of fields. As the quantity of information continues to increase and these collections expand, there is a need for a repository system that can provide appropriate storage and access to all these valuable materials in a flexible and extensible manner for the foreseeable future. This need has led many geological organizations and experts to select a geodiversity information system solution. This system can assimilate current collections and accommodate new materials by dealing with highly structured geological data (such as rock, soil, and topographical data) and complex spatial relationships as they become available to global users. In fact, several project have been developed to handle varied datasets and issues of geological domain based on the developers interest and needs, such as geological hazard spatial information system [5] and web-based geographic information system [6].

Lee and Choi research work [5] focused on the datasets that considers the geological hazard management, assessment and prediction in the development of their geological information system. In this work, a geological hazard spatial database (SDB) was designed and constructed. Among the data structures used were coverage (vector data), GRIDs (raster data), and images (raster data). The SDB includes geological hazards, basic maps damageable objects, satellite imaging, meteorological data and terrain analysis data. To use the constructed SDBs, a geological hazard spatial information system was developed. In this information system, the SDB output can be selected according to scale. The system used GUI that allows the development of a user-friendly application. It also featured many functions such as retrieval, identification, edit, and help.

The main objective of Chang and Park study is to develop a Web-based Geographic Information System (GIS) model for efficient management of borehole and geological data [6]. They claimed that GIS application development adopting internet technology was essential because the efficiency of data usage and knowledge sharing is very important in the developing countries. This project suggested a borehole data standard and corresponding database. More than 10,000 boreholes and other geological data were archived into the database. A prototype for Web-based GIS application was successfully designed to provide systemic interfaces and functions such as geological information search, on-line geological functions, statistical summaries and administrative functions. Geological data from many construction projects should be standardized, structured, archived and properly used through suitable system and applications for efficient management. However, there yet remain many important problems to be solved for advanced GIS applications. One problem comes from the requirement of suitable standards for geological data and good design of geological database. Another problem comes from the requirement of a suitable

modeling approach that is essential to maximize the sharing of geological information and knowledge to solve problems related to geotechnical engineering.

3. Research Objective

The research objective to be achieved includes:

- To introduce a digital object (DO) definition
- To establish a data model for geodiversity
- To design and implement Geodiversity Repository (MyGeo)
- To capture the Langkawi geodiversity data into a single repository
- To provide geodiversity data for tourism industries

4. Research Approach

In this research, theoretical and experimental approaches are adopted to finally produce a usable repository.

Initial study involves collecting sample data of geodiversity for Langkawi. The samples are collected and analyze in order to understand the complexity of the information needed as well as their relationships. The next phase is the Data representation formulation. In this phase, a DO structure and definition is formulated and tested to a certain level of optimization (the use of data normalization approach is expected to be beneficial). With a well defined DO, a workable conceptual repository structure for Langkawi Geodiversity is developed and tested. With regard to toolset design and implementation, a commercial database engine will be used to implement the development of the repository named as MyGeo. Once the MyGeo is approved for deployment, the Langkawi geodiversity data will be captured, digitized and populated into the repository. The MyGeo is then ready to be published to public.

5. System Analysis

The target users for MyGeo includes tourism sector and the general public who are interested in geodiversity. In the system analysis phase, methods had been undertaken to establish user needs. Initially, the research team consisting of postgraduate students and researchers from two domains; information technology and geodiversity experts held initial discussions on the research domain areas specifically on geodiversity and system design. The discussion revolved around the understanding of the concept of geodiversity from the perspective of geological heritage research, geoconservation and geographical landscape tourism. The research team had visited several geoparks in Langkawi to observe and better understand the information needed as well as their relationships. The information required to established user needs was decided through a number of focus groups and through several method includes structured interviews, group discussion and workshop and collaboration with Langkawi Development Authorities or best known as LADA . Here, user needs were determined by measure of regular consultation between the development teams led by experienced software engineers and data design with the users who are represented by geodiversity experts through workshops and brainstorming session among these three expert groups. This encouraged a sense of participation in the development process by users. The next phase is the development of architecture. Figure 1 shows the architecture of Malaysian Geodiversity Repository System(MyGeo-RS).

6. MyGeo-RS Architecture

The basic data flow of MyGeo-RS is represented in an architecture that has been designed and is shown in Figure 1. MyGeo-RS is a metadatabase that will use geodiversity data as the input to produce or present digital objects of the geodiversity domains. Three categories of the digital objects representation have been identified and selected which consist of Artifacts Digital Objects, Geosites Digital Objects and Landscape Digital Objects. The category selection was based on information from our geodiversity experts and was focusing specifically in Langkawi.

From our initial study, the metadatabase will consist of three levels of input. The first level will be information on the description of geodiversity types which we obtained from the geological experts. The second level will be the information on description of the data sets that is inter-related from the underlying sources of the geodiversity types described. The third level will describe the information on the actual geodiversity data that have been documented and collected in forms of existing databases, files and other digital types, which includes images, reports, maps and video. Geodiversity metadata can then be produced using the data from these three levels of input.

MyGeo-RS will access the input data through the geodiversity metadata and also the actual geodiversity data which will then be processed into the digital objects representation according to the selected categories. One of the modules in MyGeo-RS will be a classification module of geodiversity types. At this initial stage, the classification process will be categorized into two categories; attributes and services .The attributes will be described by our geodiversity experts and in accordance to the geodiversity types agreed. The potential services that have been seen to be of interest are tourism, knowledge and products.

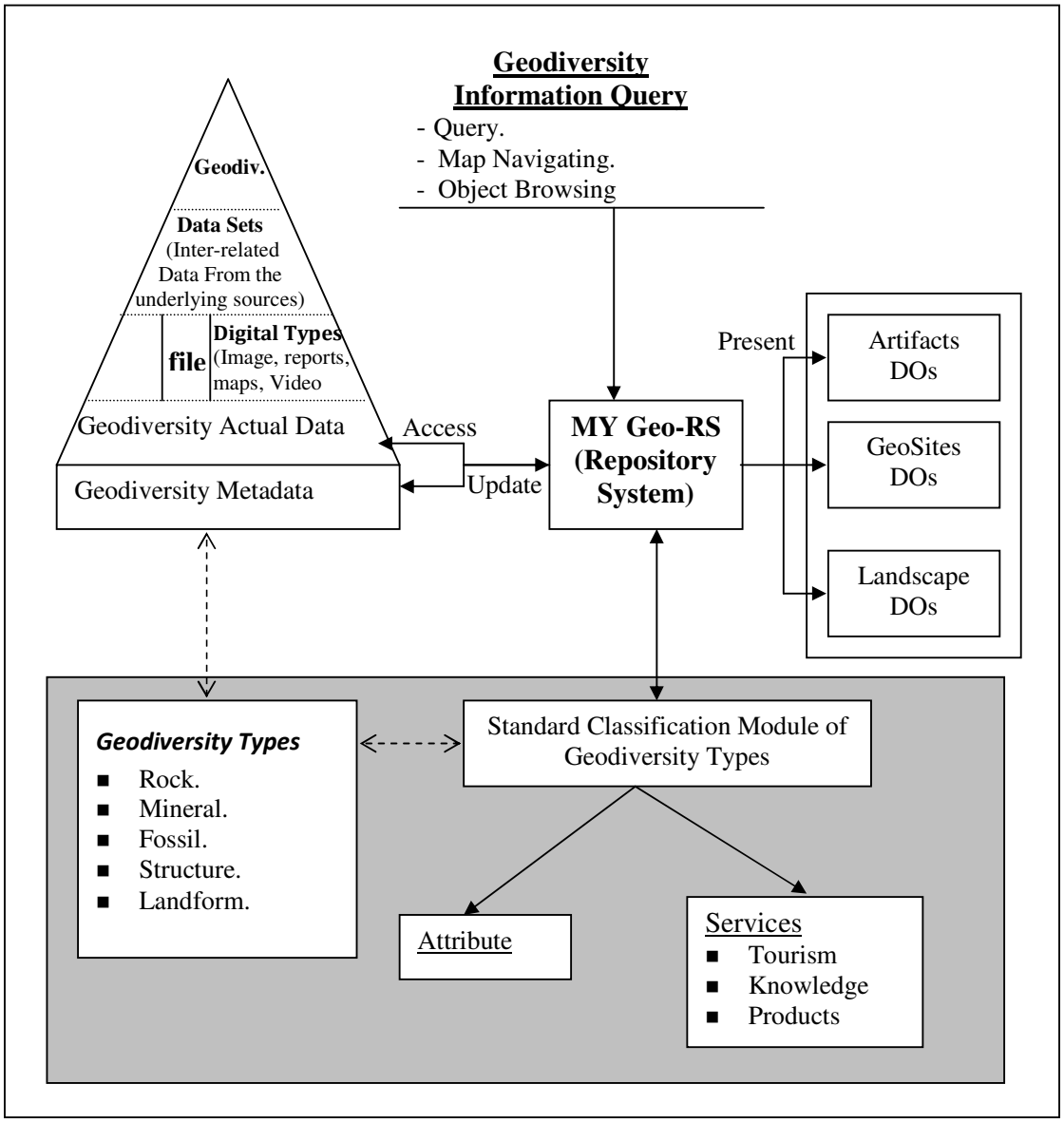

Fig 1. The architecture of MyGeo-RS

7. Conclusion

The development of MyGeo-RS, a geodiversity repository system is a timely effort and a suitable solution that can assure the management and preservation of geological datasets to be made more interesting, accessible and shared to the public at large. This research was embarked based on the realization that with the advancement of information and communication technology, as well as data mining and knowledge discovery, knowledge about geodiversity can be better represented and explored. This project attempts to establish on how geodiversity components and their relationships can be modeled into various forms of digital object (DO) to enable access and sharing of geodiversity information. The target user groups of this project are mainly to public users and tourism industry. This mean that the data captured and provided in this project is suitable for these groups but at the same time giving little contribution to scientific applications. This will be the limitation of current design and architecture and further work need to be done to accommodate the scientific requirements.

This project is an on-going project which will be completed in about a year time. Further analysis and evaluation need to be implemented and more documents will be published in the near future.

8. Acknowledgement
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