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Research Article

Analysis of Tools for The Description and Analytical Processing of Enviromental Data

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Abstract: The objects of the research are tools that support the description and analytical processing of environmental data requests. These tools are used for environmental monitoring. Analytical processing of environmental data is necessary for this monitoring by the persons concerned. Here, a star schema is used to describe the data. Analytical data processing tools are required for analysis and research of environmental data. The results of analytical processing of environmental data are used to speed up decision-making. This article also describes the structure of the analytical data processing tool. Therefore, one of the problem points is how to describe the data. For this purpose, an environmental data relay scheme is defined, and the data description is implemented in multidimensional cubes. Due to the growth of data volume, data processing is carried out using multi-dimensional visualization methods. In addition, a visual user interface has been created for analytically processing queries based on scale data. The result of this research is to find a method for describing environmental data. At the end of the research, a hypercube was obtained, with the help of which it was possible to structure environmental data and carry out analytical processing of them. To this end, environmental data have been described using a multi-dimensional visualization method. And OLAP technologies were used to carry out analytical processing of this data. OLAP technologies allow aggregate data to be used and presented as a hypercube. The results of the research can be used as a basis for an environmental information system that is used for environmental monitoring.

Keywords: environmental monitoring, information communication, hierarchical scheme, factual data, analytical processing, multidimensional model

Introduction

Organization of monitoring for environmental protection and control, visual observation of environmental processes is carried out with the use of modern analytical tools [1, 2]. Such applications lead to better oversight of operational management and accelerate decision-making. Environmental data analytics software is a multifunctional system that performs data analysis and research [3, 4]. There is a great need for analytical processing of data to interpret the results and classify information over the years to ensure long-term retention of the analysis obtained during environmental monitoring [5, 6]. As a result of analyzing the dynamics of pollutant fluctuations at different points of entry (facilities) at the Caspian Sea, decisions are made based on the time interval. Management decisions for the organization of monitoring are «top-down» and information (monitoring results) is «bottom-up». Thus, decision-makers for each level are provided with information reflecting the environmental status of that level. The upper level transmits aggregated information [7, 8].

Analytical processing systems are provided with information source (monitoring) and control components for environmental data processing and direct and reverse feedback links are established between the system's elements [9, 10]. This kind of information communication improves the management process and simplifies the decision-making process. Here, management is organized for adaptive managing of monitoring activities [11, 12]. The software we are talking about should include periodic reports on the volumes of waste generated by the Caspian Sea coastal zone and reflect the dynamics (composition of the

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ingredients). [13] This dynamic is determined by separate areas (objects, outputs) according to the input data and should respond to different user requests based on this information [14, 15].

The relevance of the research is due to the high level of pollution of the Caspian Sea. Thus, the object of the research is selected means of describing and analytical processing of environmental data. And the aim of the research is to create a hypercube to describe environmental data.

Materials and Methods

New methods and technologies are currently being used to describe the data. The «star» scheme for the environmental data analysis is illustrated in Figure 1. The figure is based on a specific history (sample history) of the data warehouse, which stores data on pollutants discharged from the sea and their contents. The relationships between the tables are shown in lines. The cells describing the key attributes of the tables are depicted in blue.

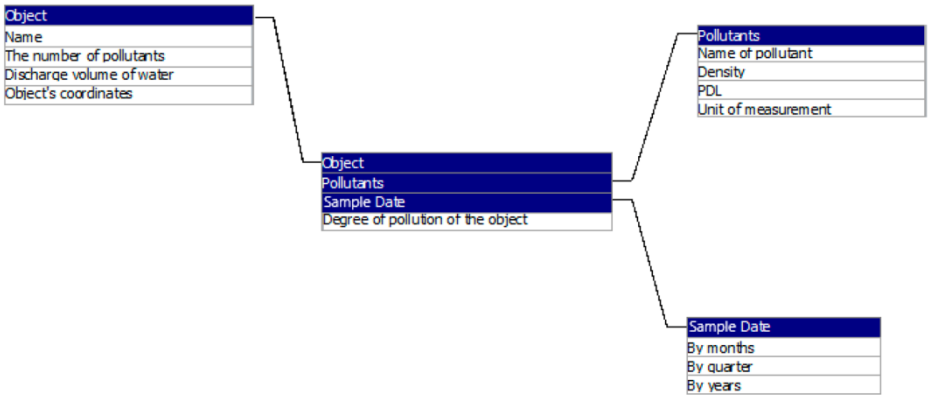

Figure 1. Relationship model with the «Stars» scheme

As the volume of data in the system grows, it is not possible to perform any analysis on them using ordinary methods. For this reason, multiple-dimensional imaging techniques are applied to the data. In this case, there is a need for multi-dimensional, operational and analytical data processing. For this purpose is used OLAP (On-Line Analytical Processing – Operative Analytical Processing) technology. The main difference of OLAP analysis from other analyzes is the use of hyperchub images and the analysis of aggregates. This method allows users to view various types of data as soon as they like. Aggregate data is stored in cells to expedite the analysis.

It is advisable to use a multi-dimensional model of space data to perform mathematical data analytic processing. The values of the dimension variables for the description of information in a multidimensional space are shown as V (indicator – composition), O (object – names of objects) and Z (time – analysis dates) as follows:

$$V = \begin{Bmatrix} v_{11} & v_{12} & \cdots & v_{1m} \\ v_{21} & v_{22} & \cdots & v_{2m} \\ \vdots & \vdots & \cdots & \vdots \\ v_{k1} & v_{k2} & \cdots & v_{km} \end{Bmatrix},$$

$$O = \begin{Bmatrix} o_{11} & o_{12} & \cdots & o_{1k} \\ o_{21} & o_{22} & \cdots & o_{2k} \\ \vdots & \vdots & \cdots & \vdots \\ o_{m1} & o_{m2} & \cdots & o_{mk} \end{Bmatrix};$$

$$Z = \begin{Bmatrix} z_{11} & z_{12} & \cdots & z_{1k} \\ z_{21} & z_{22} & \cdots & z_{2k} \\ \vdots & \vdots & \cdots & \vdots \\ z_{n1} & z_{n2} & \cdots & z_{nk} \end{Bmatrix}.$$

The sets of V, O, and Z are defined by the multiplication of the decarction output, resulting in the multiplication of WHO pricing, which consists of a large number of elements. In the hypercube derived from the majority of decartile production, the description of aggregate data is realized.

Results and Discussions

The hypercube derived from matrices' decarction output shows a description of the aggressive data. Data on the pollution levels of the discharges of seawater from objects (exits) on the history of water samples were collected in the indicated hypercube. Performs the depiction of pollution rates over the cube for years. Thus, the description of the facts on the cube is in the form «Years×Pollution×Objects». The coordinate system reveals that the dynamics of years on the first side of the cube – on the X axis, on the second side of the cube are the names of the common objects – on the Y axis, and on the third side – the Z-axis, the vector of pollution rates for each year is analyzed based on the facts obtained from X and Y.

The creation of a multi-dimensional imaging tool works with pre-existing data sets. This kind of description allows operative processing of information to make decisions. The description and processing of the data are more visual and informative.

Environmental data analytics is based on the concept of a database. Analytical processing allows users to view various types of environmental data as soon as they want, and the multi-dimensional description of the data is more visual and informative. A software tool for analytical processing of environmental data has been developed.

Conclusions

A multidimensional model has been proposed for environmental analytical processing to enable management in environmental monitoring systems, and software for the Delphi environment for information visualization interface has been developed. Using these tools, analytical processing of surveys can be applied to both newly designed and existing environmental information management systems. The tools outlined in the article provide extensive opportunities to effectively address complex environmental control issues and simplify management decision-making.

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