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Proposed GIS Model for Natural Resources Development and Environment Management

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***Abstract*– A convenient way to define a Geographical Information System (GIS) is to say that it is a set of computer tools capable of storing, manipulating, analyzing and retrieving geographic information. Several questions arise from this definition. What exactly is geographic information; and what is meant by the sentence 'storing, manipulating and analyzing and retrieving geographic information'? Both these questions are the cause of much discussion and research in the GIS society. This paper will touch upon the first question, and will discuss thoroughly an approach for GIS model for Natural Resources Development and Environment Management. In this context GIS model can be regarded as a subset of 'manipulating and analyzing geographic data'. In this paper we proposed a GIS model which contributed in Natural Resources Development and Environment Management.**

***Index Terms*– Geographic Information System, Natural Resources Development, Environment Management, Image Processing, Data Warehouse, Operation Source Data and OLAP Tool**

I. INTRODUCTION

RESPONSIBLE and successful environmental management is necessary for protecting and restoring the natural resources. The interdependency of the earth's ecosystems and the human impact on the environment present complex challenges to governments and businesses as well as scientists and environmentalists in every discipline.

Geographic information system (GIS) technology is used to support and deliver information to environmental managers and the public. GIS allows the combination and analysis of multiple layers of location-based data including environmental measurements. The environmental application areas of GIS are varied in terms of potential users, environmental spheres, and the specific environmental issue being investigated [3].

Geographic information is information that has a geographic attribute, that is, it is linked to some location. We can recognize two main types of geographic information. The first type relates to the concept of objects, features that can have a certain set of attributes.

The second important aspect of the definition of GIS is the capability for manipulating and analyzing the geographic information. Manipulating and analyzing refer to retrieving data from the geographical database and creating new information by combining this data.

The rest of the paper is organized as follows. In next section we discuss the environmental model and GIS. In section III we discuss the integration of environmental model and GIS. Section IV shows architecture of proposed GIS model and functioning of each tool and also the algorithm and Flowchart of proposed GIS model. Section V includes the findings and result of proposed GIS model. And finally we conclude in Section VI.

II. ENVIRONMENTAL MODEL AND GIS

As given above, GIS can be defined as a system designed for storing, retrieving and manipulating geographical data. Several other authors give similar definitions. As defined above, GIS is a broad and very unspecific venture in which many disciplines participate. An important aspect of GIS is that it is a collection of generic tools, designed not for specified manipulations of geographic data, but for general purposes [4].

For the analysis of the elements of a GIS, some researcher recognizes three perspectives:

- A functional perspective concerning what applications a GIS is used for, the nature of GIS use;
- GIS procedural perspective concerning how a GIS works with regard to the various steps in the process to perform this work, the nature of GIS flow; and
- A structural perspective concerning how GIS is put together with regard to various components, the nature of GIS architecture.

In addition to these perspectives, an important one may be added:

- A conceptual perspective concerning to way a GIS can be used to model the real world.

Within the framework of this research, the functional perspective is limited to the applications of GIS for dynamic modeling in environmental applications. The structural perspective is related to the hardware and software of the

GIS. It is the design of the software that is responsible for the ease of use, the feasibility of the GIS system to be used in certain applications and the ability of implementation of a certain concept in GIS. As such, the structural design and architecture of GIS play a very important role in the discussion of linking GIS and environmental models.

The idea that GIS should be used to model the real world is gaining more and more attention. It strongly relates to the functional perspective, since for different applications we may adapt different concepts of 'reality' [1].

III. INTEGRATION OF ENVIRONMENTAL MODEL AND GIS

Several authors recognize different levels of integration of GIS and models. The simplest approach is the use of separate GIS and models, and exchange files. This approach requires at least five steps:

- Input of geographic distributed data through GIS;
- Export of GIS-data and conversion into the variables and parameters used in the model;
- Running the model;
- Importing the results of the model into GIS; and
- Analysis of the model-results and creating final maps and graphs [1].

An important extension for a fruitful integration between GIS and models would be the establishment of a common database structure that supports both GIS operations and model runs. The model becomes one of the analytical functions of the GIS, or the GIS become yet another option to generate, manipulate and display parameters, input and results of the model [2].

IV. PROPSOED GIS MODEL

By studying various GIS based environmental model, its limitations in managing and developing natural resources and environment, we would proposed a model which may be beneficial and providing efficient techniques which contributed in natural resources development and environmental management.

The Architecture of proposed Model given in following Fig. 1:

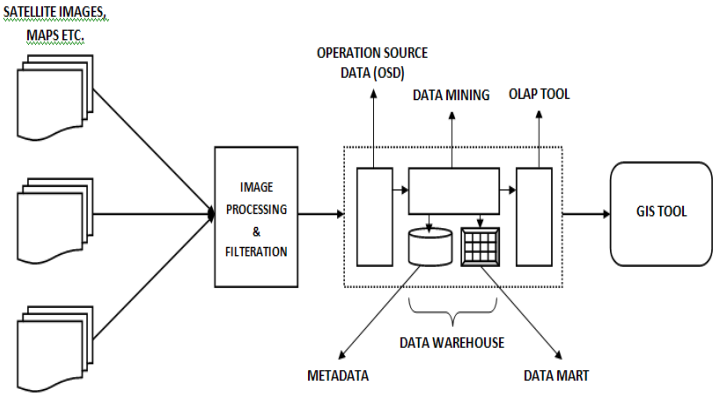

Fig. 1: Architecture of proposed GIS Model

This architecture consists of various modules and methods describe as below:

A. *Satellite Images, Maps etc*

These images or maps can be taken through satellite which is situated in orbit which is developed by the environmental planners or developers. There are number of images or maps can be captured of different objects or same object in various angle and direction. These images or maps may send to next module i.e. image processing or filtration.

B. *Image Processing and Filtration*

Image processing is analyzing and manipulating images with a computer. Image processing generally involves three steps:

- Import an image with an optical scanner or directly through digital photography.
- Manipulate or analyze the image in some way. This stage can include image enhancement and data compression, or the image may be analyzed to find patterns that aren't visible by the human eye. For example, meteorologists use image processing to analyze satellite photographs.
- Output the result. The result might be the image altered in some way or it might be a report based on analysis of the image.

Thus image processing and filtration module helps in selecting the appropriate image or map of an object.

C. *Operation Source Data (OSD)*

Now the image or map is processed by image processing and filtration is generally consisting of some data. For example if we select a map of land resource of Nagpur city then we have to analyze the data which maps shows by using different techniques of collection of data. An *operational source data* is a database designed to integrate data from multiple sources for additional operations on the data. The data is then passed back to operational systems for further operations and to the data warehouse for reporting.

Because the data originates from multiple sources, the integration often involves cleaning, resolving redundancy and checking against business rules for integrity.

D. *Data Warehouse*

Data warehouse (DW) is a database used for reporting and analysis. The data stored in the warehouse is uploaded from the operational systems. The data may pass through an operational data store for additional operations before it is used in the DW for reporting.

A data warehouse maintains its functions in three layers: staging, integration, and access. *Staging* is used to store raw data for use by developers. The *integration* layer is used to integrate data and to have a level of abstraction from users. The *access* layer is for getting data out for users.

Data warehouse include mining of data, metadata and data mart:

1) Data Mining: (sometimes called data or knowledge discovery) is the process of analyzing data from different

perspectives and summarizing it into useful information - information that can be used to increase revenue, cuts costs, or both.

Data mining consists of five major elements:

- Extract, transform, and load transaction data onto the data warehouse system.
- Store and manage the data in a multidimensional database system.
- Provide data access to business analysts and information technology professionals.
- Analyze the data by application software.
- Present the data in a useful format, such as a graph or table.

Different levels of analysis are available:

- Artificial neural networks
- Genetic algorithms
- Decision trees
- Nearest neighbor method
- Rule induction
- Data visualization

2) Metadata: is structured information that describes, explains, locates, or otherwise makes it easier to retrieve, use, or manage an information resource. Metadata is often called data about data or information about information.

3) Data Mart: is the access layer of the data warehouse environment that is used to get data out to the users. The data mart is a subset of the data warehouse which is usually oriented to a specific business line or team.

Reasons for creating a data mart

- Easy access to frequently needed data
- Creates collective view by a group of users
- Improves end-user response time
- Ease of creation
- Lower cost than implementing a full data warehouse
- Potential users are more clearly defined than in a full data warehouse

Thus data warehouse including mining of data, metadata and data mart helps to store, retrieve and delete the information available with the image or maps.

E. OLAP Tool

Online Analytical Processing, or OLAP, is an approach to swiftly answer multi-dimensional analytical (MDA) queries. OLAP is part of the broader category of business intelligence, which also encompasses relational reporting and data mining. Typical applications of OLAP include business reporting for sales, marketing, management reporting, business process management (BPM), budgeting and forecasting, financial reporting and similar areas, with new applications coming up, such as agriculture. The term *OLAP* was created as a slight modification of the traditional database term OLTP (Online Transaction Processing) [5].

Here OLAP is used to analyze and solve various database queries and convert these queries into the appropriate form which user can directly understand and used these results for their research.

F. GIS Tool

A geographic information system (GIS) integrates hardware, software, and data for capturing, managing, analyzing, and displaying all forms of geographically referenced information. GIS allows us to view, understand, question, interpret, and visualize data in many ways that reveal relationships, patterns, and trends in the form of maps, globes, reports, and charts. A GIS helps you answer questions and solve problems by looking at your data in a way that is quickly understood and easily shared.

GIS technology can be integrated into any enterprise information system framework. GIS as tool, involving the use of a particular class of software, associated hardware tools, and digital geographic data in order to advance some specific purpose. GIS as tool making, involving the advancement of the tool's capability and ease of use; and the science of GIS, concerning the analysis of the fundamental issues raised by the use of GIS [6].

GIS tool integrated with its related technology like Global Positioning System, Remote Sensing, Desktop Mapping, Computer Vision etc.

1) Algorithm for Proposed GIS Model:

The algorithm for the above proposed GIS model is given as below which helps in actual understanding of the architecture.

STEP1: START

STEP2: ACCEPT INPUT AS Satellite Images or Maps and its Data.

STEP3: PROCESS and performed FILTERATION on Satellite images or a map and its Data.

STEP4: ACCEPT related Data of Satellite Images or Maps.

STEP5: PROCESS Data and GOTO STEP 6.

STEP6: PROCESS Data and Convert into Information. DELETE the irrelevant Data which is not required for Further Processing. KEPT the Deleted Data in History Tool and GOTO STEP 7.

STEP7: STORE the Data within Data in METADATA Module and GOTO STEP8.

STEP8: STORE each piece of Information in DATA MART. STORE information in ORDER=ASC/ DESC.

STEP9: PROCESSING, Handling Queries, preparing REPORTS, BUDGETS and FORECASTING using OLAP Tool.

STEP10: INTEGRATING all Information Using GIS Tool.

STEP11: DESIGN SYSTEM using GIS Tool.

STEP12: STOP

2) Flowchart for Proposed GIS Model:

Following Fig. 2 shows the flowchart for proposed GIS model.

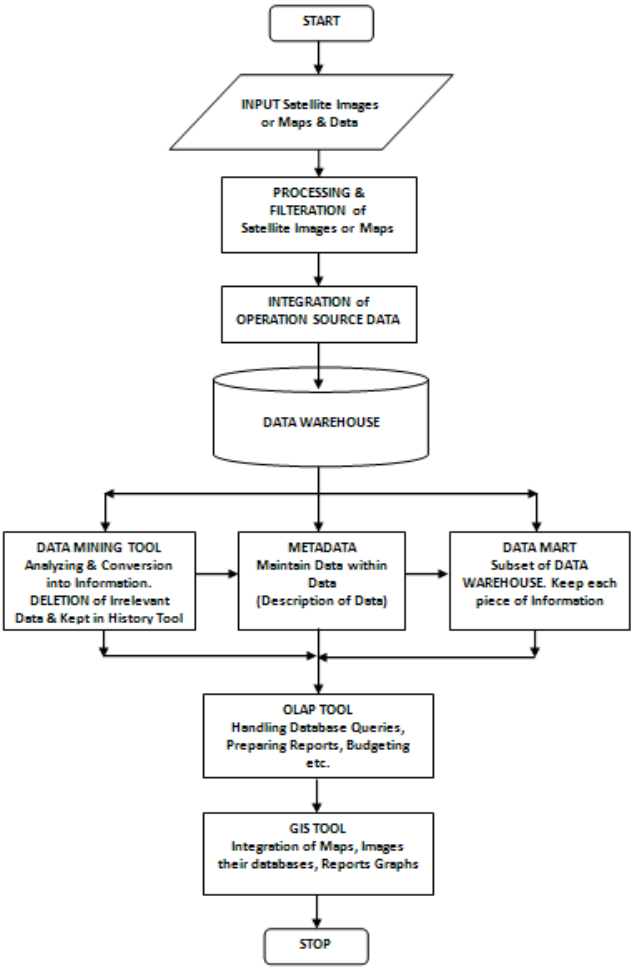

Fig. 2: Flowchart for proposed GIS model

V. FINDINGS AND RESULT

Thus the above model can be benefited in environmental management and natural resource development and provide solutions which enable any organizations who work on environmental management to:

- Ensure accurate reporting with improved data collection.
- Improve decision making.
- Increase productivity with streamlined work processes.
- Provide better data analysis and presentation options.
- Model dynamic environmental phenomena.
- Create predictive scenarios for environmental impact studies.
- Automate regulatory compliance processes.
- Disseminate maps and share map data across the Internet.
- Database-sharing architecture that supports decision making and daily work tasks
- Interoperable system solutions for integrated workflow and data access
- Internet mapping solutions that support interagency collaboration projects
- Quality control processes that ensure accurate, high-quality data
- Worker-friendly designs that increase agency-wide access and application
- Scalability that supports and adapts to growing and evolving IT demand

VI. CONCLUSION AND SUGGESTIONS

Even though obstacles remain to their full deployment, GIS technologies now being developed and demonstrated suggest natural resource applications that were not believed possible using traditional techniques. As we progress towards the long talked about notion of integrated natural resources development, some parallel continuums along which the technology manifests are:

- The technology helps create integrated views of databases that span the levels of map scale, detail and use. This helps in understanding the earth's ecology.
- The technology meets the need for information presentation tools, as the pendulum swings towards community place based management.
- The emergence of shared data infrastructure and accelerated information delivery, e.g. Internet data ordering.
- Significant advances in data acquisition technology.
- Rapid improvement in data storage, retrieval and analysis.

We suggested that, since the model is integrated in GIS, all common GIS-tools for deriving new digital maps from a combination of existing maps and interpolation of coarse point-data to a fine resolution data-set are available. The tools are integrated in a seamless way; extraction of necessary information can be done as part of the model description. Again a word of caution: the system cannot check whether relations assumed by the user have actual validity, and the responsibility for correctness is completely with the user.

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