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GROUND WATER DATA STORAGE AND RETRIEVAL SYSTEM

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ABSTRACT

Management of large volumes of ground water data observed under variable exploitation and replenishment conditions needs a scientific basis for mass storage alongwith facilities for selected retrieval. A computerised ground water data storage and retrieval (GWDSR) system has therefore been developed using relational database model and a suitable structuring technique. The system is capable of adding new data and modifying/retrieving the existing data from the database through a common controlled approach and performing selected statistical computations besides others. The system has successfully been implemented for storage and retrieval of ground water level of wells at several locations in the U.P. State as a case study.

KEY WORDS : Database, Relational model, structuring Technique, Data Storage and retrieval system.

INTRODUCTION

Increasing demand on water over the years has necessiated development of underground sources of water as complementary to surface water resources. Systematic and scientific development and management of ground water is primarily based on related data needing thereby an exhaustive data base incorporating the variability in the ground water data caused due to variable exploitation and replenishment. Creation of this data base in a specified format would serve little purpose as long as it is coupled with efficient management techniques for their storage and retrieval. Even though significant progress has been made in the various data collection techniques, the storage and retrieval of these data are mostly done through conventional techniques which have a number of drawbacks such as involvement of lots of manpower, loss/damage of records hence in loss of data, lot of storage space and difficulties in timely retrieval of desired data in the desired format.

To overcome these difficulties commonly encountered by the designers, scientists, managers and planners and taking into account of the growth computing facilities, a computerised Ground Water Storage and Retrieval (GWDSR) system has been developed.

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CONCEPT OF DSR

In a computer based data management system, problem of many users sharing a common file or records may exist. This can be overcome by storing together interrelated data with controlled redundancy in a large reservoir called a Database.

Data in a GWDSR system are stored in such a way that they are independent of the programs which use the data. A common and controlled approach is adopted in adding new data and modifying/retrieving the existing data within the designed database. In fact, a GWDSR system is a software interface between a ground water database and an user. Using the GWDSR system the data are stored in files which are abstract collection of ASCII characters. The files are stored on magnetic storage media. The required data should reside on magnetic disk. At the time of retrieving the data if the required file is not available on magnetic disk then it is first copied from magnetic tape to magnetic disk.

SYSTEM DESIGN

Database Models

The system design primarily consists of a choice of a suitable database model, a suitable technique for enabling the user to establish the structure of the data base and to provide an easy way for retrieval, management,updation and deletion of a record of the database.

In a database, the data is structured using the data models. The three major models used for organizing a database are hierarchical, network and relational. A particular DSR system is generally designed to support only one of these models. In the present GWDSR system, the relational model has been used. It is based on presenting data in the form of tables or relations as shown in Fig.1. Each horizontal row is a record and data items are shown in the column. The relational database structure shows relationships among records by linking tables together as needed. The major advantage of the relational model is that any combination of data in the data base can be easily retrieved. Links between data records can be established by users' commands as the need arises. This great flexibility allows the relational database to be easily configured to answer new and unanticipated questions. In hydrology, generally long data series at a number of sites are encountered and therefore the best data retrieval can be accomplished using this model. Further, addition of new data to the existing data base is also easiest in this model.

Capabilities of GWDSR System

The GWDSR system can be used to perform the following tasks :

(i) Basic operations of file handling like creation, deletion renaming and modification.

(ii) Replace a particular field in the entire file with a specified quantity.

(iii) Collect certain items from a file (say A) certain item from another file say B) and store them in a new file (say C) in the desired format.

(iv) Replace a particular field in the entire file by an expression.

(v) Statistical calculations of a particular field from specified records.

(vi) Report generation in a desired format

(vii) Sort a file using upto 10 keys

(viii) Incorporate new fields.

From the point of view of these basic manipulations for which easy interactive procedures have been developed, the following attributes for any data file have been decided:

(i) Its ORGANIZATION is SEQUENTIAL

(ii) Its RECORDTYPE is FIXED length

(iii) Its FORM is UNFORMATTED.

These attributes cause minimum overheads on the system because a sequential, fixed record length file allows direct access and permits easy implementation of retrieval, updating and deletion of a record.

Structure Definition

The information regarding the structure of a record i.e. characteristic of each field in each record is stored in a separate file (.DEF type). The attributes of a field are :

i) Field number - It resolves the position of the field in a record.

ii) Field name - It identifies a particular data item in a record.

iii) Field size - It gives the number of characters contained in the field.

iv) Data type (C/I/R) - It identifies the type of data represented by field.
C is for character datatype, I is for integer data type and R denotes real data type.

v) Places after decimal point - It is used to justify a real data type.

vi) Lower range of data - It is used in data integrity checks

vii) Upper range of data - It is also used in data integrity checks.

viii) Auto duplicate(Y/N) - Sometimes the data is such that a particular data item keeps on repeating in each record. To assist the user such that he need not enter this data item in each record, this flag has been provided. Upon setting 'Y', it causes the GWDSR system to copy the associated data item from the previous record.

ix) Autosequence (Y/N) - Many data items move in sequence. This flag can be used to facilitate easier entry for such data items i.e. if thefield number is being autosequenced, it is automatically increased by step size if this flag is set to 'Y'.

x) Step size - It can be set to an integer value which is used as an increment in that data item from one record to another.

xi) Verify (Y/N) - Upon setting to 'Y', this flag causes the GWDSR system to validate the data items for consistency checks using the descripters 4, 6 and 7. Conflicts, if any, are desplayed on the terminal.

CASE STUDY

The ground water data of U.P. State provided by Ground Water Investigation Organisation, U.P. have been used in the GWDSR system. The following structure has been designed for the available data, which can be updated/altered with the need.

Table 1 - Structure Definition for the GWDSR System

Number	Field name	Field size	Data type	Decimal	Lower range	Upper range
01	SNO	9	I	0	1	999999999
02	DISTRICT	15	C	0	0	0
03	BLOCK	15	C	0	0	0
04	STATION	15	C	0	0	0
05	WELLNO	6	C	0	0	0
06	LATITUDE	6	C	0	0	0
07	LONGITUDE	7	C	0	0	0
08	RELEVEL	8	R	3	1	500
09	YEAR	2	I	0	1	90
10	MONTH	2	I	0	1	12
11	DATE	6	R	2	1	100

CONCLUSION

A computerised GWDSR system has been developed which uses the physical and logical data descriptions to extract the data items required by the users from the database.

The characteristics of the developed system are -

* Multiple uses of data
* Clarity
* Accuracy and consistency
* Privacy of use
* Timely data availability
* Physical and logical data independence
* Protection from loss or damage
* Data updating is easy
* Integrity controls
* Controlled redundancy
* Fast searching and retrieval.

The developed package is also capable of performing selected statistical computations.

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LOCATION-1	LATITUDE-1	LONGITUDE-1	RLEVEL-1
LOCATION-2	LATITUDE-2	LONGITUDE-2	RLEVEL-2
LOCATION-3	LATITUDE-3	LONGITUDE-3	RLEVEL-3
LOCATION-N	LATITUDE-N	LONGITUDE-N	RLEVEL-N

FIG.1- DATA REPRESENTATION USING RETRIEVAL MODEL