

# Application of Database Technology in the Software of Seismic Data Acquisition

Zhaohui Huang<sup>1</sup> and E. A. Elzein Mohammed<sup>2\*</sup>

<sup>1</sup>Department of Geology, Chongqing University of Science and Technology, Chongqing, China.  
<sup>2</sup>Faculty of Pure and Applied Sciences, International University of Africa, P.O.Box: 2469, Khartoum, Sudan.

## Authors' contributions

This work was carried out in collaboration between all authors. Author ZH designed the study, performed the statistical analysis, wrote the protocol, and wrote the first draft of the manuscript and managed literature searches. Author EAEM managed the analyses of the study and literature searches. Both authors read and approved the final manuscript.

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## ABSTRACT

A software of seismic data collection was developed based on building a surface data base. The software represents a better way to manage seismic exploration data. The Browser/server (B/S) and the Client/server (C/S) are used to realize integrating the function of processing/interpreting and querying together. This study improves the methods of processing the surface seismic data on spot outdoor nowadays and accords with the demanding of digital construction of the oil field. It is very convenient to operate with this software, either on spot outdoor inputting data or querying and later processing/interpreting indoor.

*Keywords:* Seismic data; database; querying system; B/S; C/S.

\*Corresponding author: E-mail: [zein67624@yahoo.com](mailto:zein67624@yahoo.com);

## 1. INTRODUCTION

Data acquisition in the open is an important process in seismic investigations. It is needed to do surface seismic data acquisition for the right exploring method in wild, as well as relevant local processing and interpreting. Along with the developing computing technology and spreading of numerical technology on oil field, constructing of surface database and its processing, interpreting of surface seismic acquisition, as well as querying software, are all of effective progressing [1- 7].

Database is the foundation of the whole system. Its designation, construction and ports techniques are very important to running of the system. Before this surface database is completed, there was no database standard for surface experiment information in Sinopec, [8]. This surface database covers the whole of the current data in surface structure intelligence [9]. The exploring database of Shengli Oil field has been improved as an example, by changing the traditional method of manual processing/interpreting of surface experiment data and realized automatic SEG data collection. A surface experiment data processing/interpreting system and a software package for data processing/interpreting and querying have been developed. Windows XP operation system and IIS6.0 are used as a platform for the development of the Software; as well the Visual C++ and the Visual.net are also used as a developing tools for the surface data processing system and the surface data querying system respectively.

## 2. DESIGNING OF DATA MANAGEMENT

### 2.1 Designing of Database

Database is the foundation of the whole system. Its designing, constructing and ports techniques are very important to running of the system.

There are seven processes for database designation and construction:

- ① Application analysis which includes targets, assignments, holding extension and confirmation of data definition,
- ② Analysis of existing database for avoiding reconstructing and definition conflicts,
- ③ Confirming database requirements from the application targets;

- ④ Database modeling;
- ⑤ Logic analysis of conceptual schema and subschema for integrality restriction and optimization of logic designing;
- ⑥ Physical designing, i.e., final confirmation and definition of relationships, indices, conglomerations, tables and fields;
- ⑦ Data collection and packing, along with database construction, which means uniformly collecting and packing of data for the base and then constructing it.

Taking “Data framework and Filling Ordinances of Exploring Information System” by Sinopec, as reference [8], a surface seismic information database based on Oracle Database platform is constructed. There are eight tables in total: Seismic exploring and displaying datasheet, shallow refracting construction datasheet; observing system and production datasheet; micro log and production datasheet; unconsolidated product datasheet; lithology datasheet of surface spot. These eight datasheets involve all kinds of data techniques of surface framework intelligence.

### 2.2 Choice of Developing Tools

The developing of software is based on Windows XP operation system and IIS6.0. We take visual C++ as the developing tool for the surface data processing system and visual.net as the developing tool system for surface data querying system. Meanwhile, we take Access database as database managing system for surface experiments of data processing and interpretation system and Oracle 9i Enterprise Edition from Oracle as database managing system for the surface experiments data querying system [10].

We use Access in surface experiment processing/interpreting system due to its high running speed and convenience, since no installation is necessary and that it is good in spot processing adaptation. We also take Oracle Database for the following reasons: ① Oracle is good at database managing, integrality examining, security and consistence, as well as it is suitable for querying through the web; ② it is an adaptable database so that anyone can upgrade it easily; Oracle is one of the database for Shengli Oil Field’s exploring information and has its own compatibility.

### 3. FLOWCHART OF DEVELOPING THE SOFTWARE

A port is designed to transmit information from Seg2 to processing/interpreting database, then processes that information within this module, interprets it and instructs field production. The original data and interpreting results are transmitted to Oracle surface database so one can manage them numerically. That would enable us to acquire former surface data to recollection and fine processing letter (Fig. 1). The System framework and surface data processing/interpreting flow (Fig. 2).

### 4. KEY TECHNIQUES TO SYSTEM REALIZATION

#### 4.1 Combination of C/S and B/S

The Client/Server requires that every client has its own system and it requests the database that, hosted by the server. This architecture suits small LAN and is good at data security and running efficiency. While in the Browser/Server architecture the system and the database are all installed in the server and are operatable via the browser. Nowadays that is a common framework which can adapt to the big LAN and the World Wide Web, but it requires a higher capability server and its system developing is harder than the C/S. The Client/Server architecture is used in LAN, which means it has local restriction, while the B/S has no such shortcoming.

Considering the different requirements of outdoor production, we developed the processing/interpreting function system based on C/S

architecture, because we only need to process the spot information rather than the information from other spots, where it is at most a reference. Thus one have no necessary to process other's data on his or her own spot, therefore we developed acquiring function system based on B/S architecture.

#### 4.2- Designing of Input/Output Ports

##### 4.2.1 SEG 2 port

This software package involves a large amount of input data. Consulting [11] and our own receiving instruments, both of us designed a datasheet with SEG 2 port. The SEG 2 format file is the main storage method which is a binary storage frame whose internal architecture is shown in Fig. 3.

There is a lot of information in the table header, such as the shot number, version number, channel number, channel pointer and some information in ASCII, like collecting data, time, preamp, shots distance, and stake number. The size of the table header can increase as the data channel number. There is a four byte memory space for channel pointers which would point at the head of a certain channel.

The size of the table header is changeable, the former thirty-two bytes defined the size of the header, the sample number and the data length. The rest of the bytes are ASCII information, including channel numbers, sample rate, line number, shooting positions, detector positions, superimposition number and the chart fields.

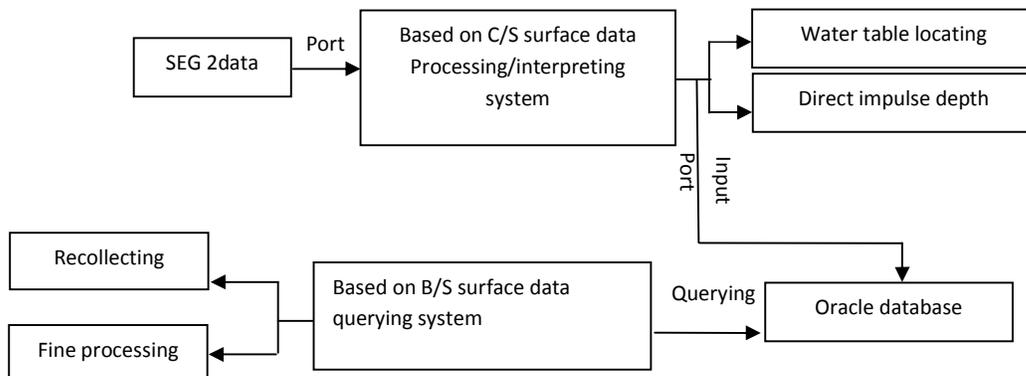
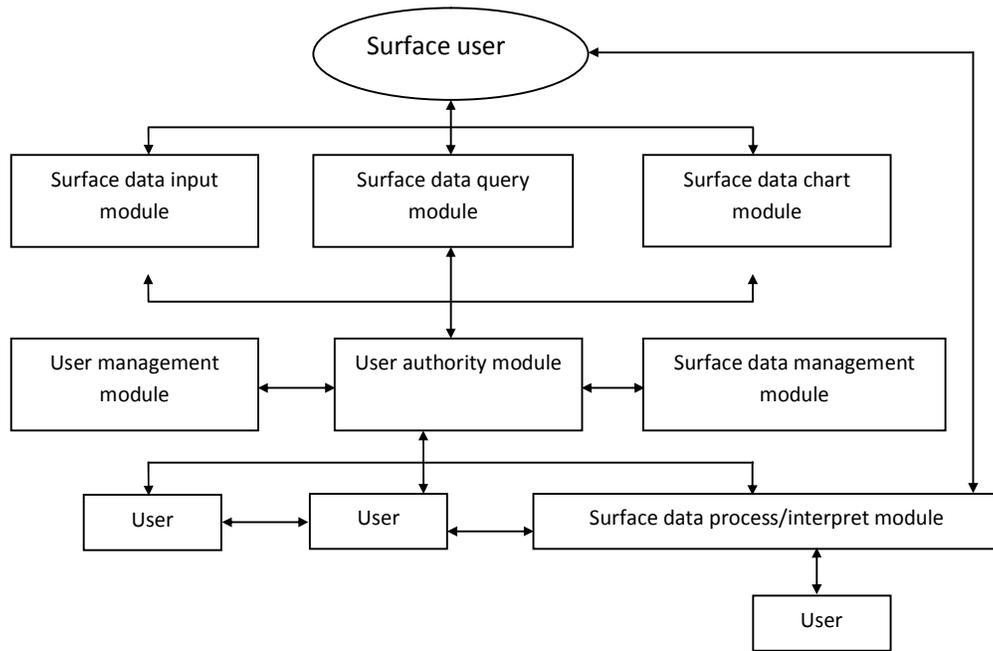
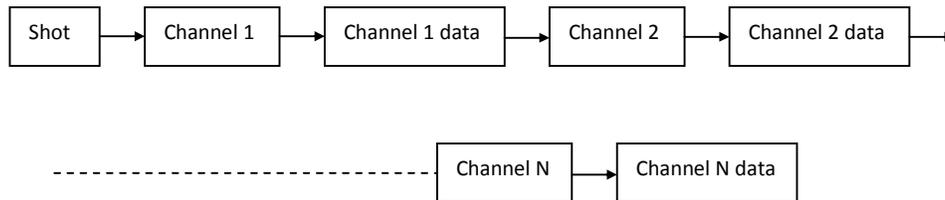


Fig. 1. System of flow chart



**Fig. 2. System framework and surface data processing/interpreting flow**



**Fig. 3. Internal structure of SEG2 file**

The Visual C++ as a programming language is used to realize the function of reading and displaying the SEG2 data and design the SEG2 class for storage characters of the second rank pointer of SEG2. Moreover, the reading and displaying ports of SEG2 class are also sealed, so that the client can transfer this port to operate the data without the restriction of familiarity with the internal framework of the SEG2 files. Meanwhile, sealing the ports can improve the coupling of the system modules which means. Thus the maintainability of the system modules has been improved.

**4.2.2 Designing and constructing of surface database**

Before this surface database is completed, there was no database standard for surface experiment information in Sinopec, [8] “data

construction and filling regular for Exploration information system of Sinopec”. Therefore, our surface database has been built based on the Oracle database plate, in which there are eight datasheets, the seismic exploring displaying datasheet, shallow refracting construction datasheet; observing system and production datasheets; micro log and production datasheets; unconsolidated product datasheet; lithology datasheet of surface spot. These eight datasheets involve all kinds of data techniques of surface framework intelligence.

This surface database covers the whole of the current data in surface structure intelligence [9]. For security of database, especially in the surface querying system which runs through the world wide website, three measures have been taken to safeguard our data and prevent attacking from outside: Keeping strict accessing

authority, only the authorized user can pass the authentication by the server. The user group has been taken as the management pattern, which authorizes a different user group for different authority, in which, server Administrator is super user and can exercise the highest right, where as the collecting user can only modify a certain spot data appointed by the server Administrator and the query data from other spots. A normal user can only browse the website. As an advantage of B/S, the normal user has an html file when any one querying the surface experiment data, but the user cannot operate the server. The advantages of security of Oracle are used to fix kinds of authorities and accessing authorities to the server.

#### **4.2.3 Transplanting from access database to Oracle database**

The client database is Access database in surface experiment data processing/interpreting software package which runs fast enough that, there is no need to install a database. Hence, it is very convenient for outdoor squad. But for realizing querying function in a wide area network and compatibility with oil field database, the surface data querying database is designed on Oracle which means that it needs to transplant the data from Access to Oracle. Therefore a special port was designed. This port is transparent to the user without necessarily knowing how much does it transmits data, since he can upload data via a click of the mouse.

### **5. THE APPLICATION AND EFFECT OF THE SOFTWARE**

A surface experiment data processing/interpreting system and a software package for data processing/interpreting and querying has been developed (Fig. 2). The exploring database of Shengli Oil field has been improved as an example, by changing the traditional method of manual processing/interpreting of surface experiment data and realized automatic SEG data collection: The system can calculate the data automatically and then build a shallow refracting and micro log distance-time diagram, unconsolidated product datasheet diagram and related diagrams; together with the querying function based on B/S, and the threshold break of terrain. It also enables one to seek the surface data intelligently through the diagram, self-definition and demanded-definition, all of which can be very conveniently operated.

### **5.1 The Processing/Interpreting System Based on C/S**

This module runs absolutely and it can process/interpret surface data indoor or outdoor. The internal database saves, processes and interprets the results and then the output would be within a certain port. This is followed by input surface data to input module, and then realizes the upload to the web.

The main functions are: Data progressing in SEG2 format, SEG2 data input, SEG2 data display, SEG2 data collecting automatically and manually, automatically calculating, result creating and saving.

### **5.2 Surface Data Querying System Based on B/S**

There are six function modules in this system which include the user authentication module, the user manage module, the data management module, the date input module, the date querying module and the data to diagram module.

The user manages the module functions by classifying the user group, authentication, describing and so on. The system can authorize different users at the same time, pointing authorization rather than pointing every user absolutely by the uniform data dictionary. Moreover a user can add, modify and edit the user group's authority.

The data management module is mainly used in data maintenance and managing, which includes maintenance of the table and fields of information.

The data input module mainly functions in all kinds of inputting task, including inputting table sheet, solid template or user-defined template, which in Excel format manually inputting function, specialized data, e.g., surface data processing/interpreting module inputting.

In data querying module, the user can define querying extension, qualification, connection and output range, and displaying. The querying result can create and define conjunction control automatically, thus can be saved conveniently for the next time. Also the querying date can be saved in an Excel.

By using the data from the database, the user can draw the types of surface charts and realize the surface data querying by the chart, which

include mainly the lithology histogram, unconsolidated depth plane trend diagram, shallow refraction distance-time diagram, and micro log distance-time diagram and so on.

## 6. CONCLUSION

The system can integrate techniques like data processing, database and computer graph; which can be realized as unifying of digital management and data processing/interpreting and querying of seismic surface experiment data. It also improves the processing method of manually processing seismic data outdoor, which shows us a new direction of digital oil field construction. This operation system is very convenient for users to visit the exploration database or later finely processing and recollecting information, as well as providing users with more details and a better storage method.

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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