

Application of Database Technology in the Software of Seismic Data Acquisition

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.

Key words: seismic data; database; querying system; B/S; C/S

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.

24 Database is the foundation of the whole system. Its designation,
 25 construction and ports techniques are very important to running of the
 26 system. Before this surface database is completed, there was no database
 27 standard for surface experiment information in Sinopec, (Exploration
 28 System Designing Group of Sinopec, 2001). This surface database covers
 29 the whole of the current data in surface structure intelligence (Weixiu,
 30 et.al, 2005). The exploring database of Shengli Oil field has been
 31 improved as an example, by changing the traditional method of manual
 32 processing/interpreting of surface experiment data and realized automatic
 33 SEG data collection. A surface experiment data processing/interpreting
 34 system and a software package for data processing/interpreting and
 35 querying has been developed. Windows XP operation system and IIS6.0
 36 are used as a platform for the development of the Software, as well the
 37 Visual C++ and the Visual.net are also used as a developing tools for the
 38 surface data processing system and the surface data querying system
 39 respectively.

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41 **2- Designing of data management :**

42 **2.1 Designing of database**

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

46 There are seven processes for database designation and construction:

47 ① Application analysis which includes targets, assignments,
48 holding extension and confirmation of data definition,

49 ② Analysis of existing database for avoiding reconstructing and
50 definition conflicts,

51 ③ Confirming database requirements from the application targets;

52 ④ Database modeling;

53 ⑤ Logic analysis of conceptual schema and subschema for
54 integrity restriction and optimization of logic designing;

55 ⑥Physical designing, i.e., final confirmation and definition of
56 relationships, indices, conglomerations, tables and fields;

57 ⑦ Data collection and packing, along with database construction,
58 which means uniformly collecting and packing of data for the base and
59 then constructing it.

60 Taking “Data framework and Filling Ordinances of Exploring
61 Information System” by Sinopec, (2001) as reference, a surface seismic
62 information database based on Oracle Database platform is constructed.

63 There are eight tables in total: seismic exploring and displaying datasheet,
64 shallow refracting construction datasheet; observing system and
65 production datasheet; micro log and production datasheet; unconsolidated
66 product datasheet; lithology datasheet of surface spot. These eight
67 datasheets involve all kinds of data techniques of surface framework

68 intelligence.

69 **2.2- choice of developing tools**

70 The developing of software is based on Windows XP operation
71 system and IIS6.0. We take visual C++ as the developing tool for the
72 surface data processing system and visual.net as the developing tool
73 system for surface data querying system. Meanwhile, we take Access
74 database as database managing system for surface experiments of data
75 processing and interpretation system, and Oracle 9i Enterprise Edition
76 from Oracle as database managing system for the surface experiments
77 data querying system (Damping Li and Xenia Zhang, 2003).

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

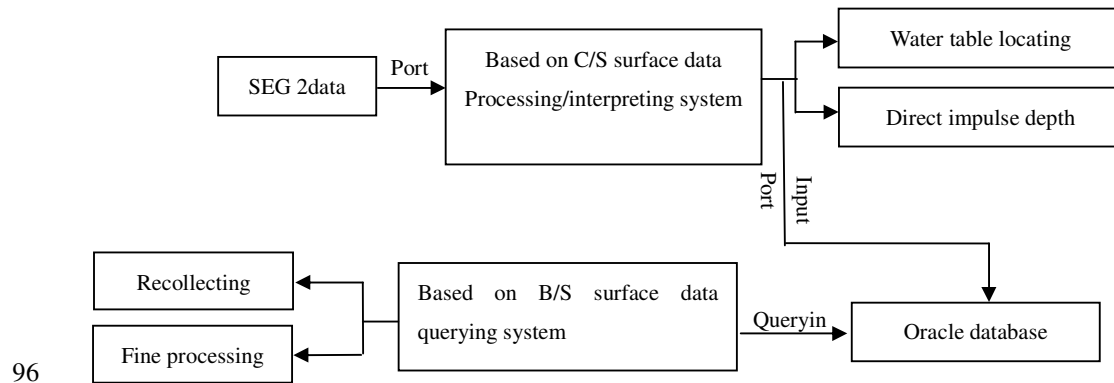
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87 **3- Flowchart of developing the software:**

88 A port is designed to transmit information from Seg2 to processing
89 /interpreting database, then processes that information within this module,

90 interprets it and instructs field production. The original data and
 91 interpreting results are transmitted to Oracle surface database so one can
 92 manage them numerically. That would enable us to acquire former
 93 surface data to recollection and fine processing letter (Fig.1). The System
 94 framework and surface data processing/interpreting flow (Fig. 2).

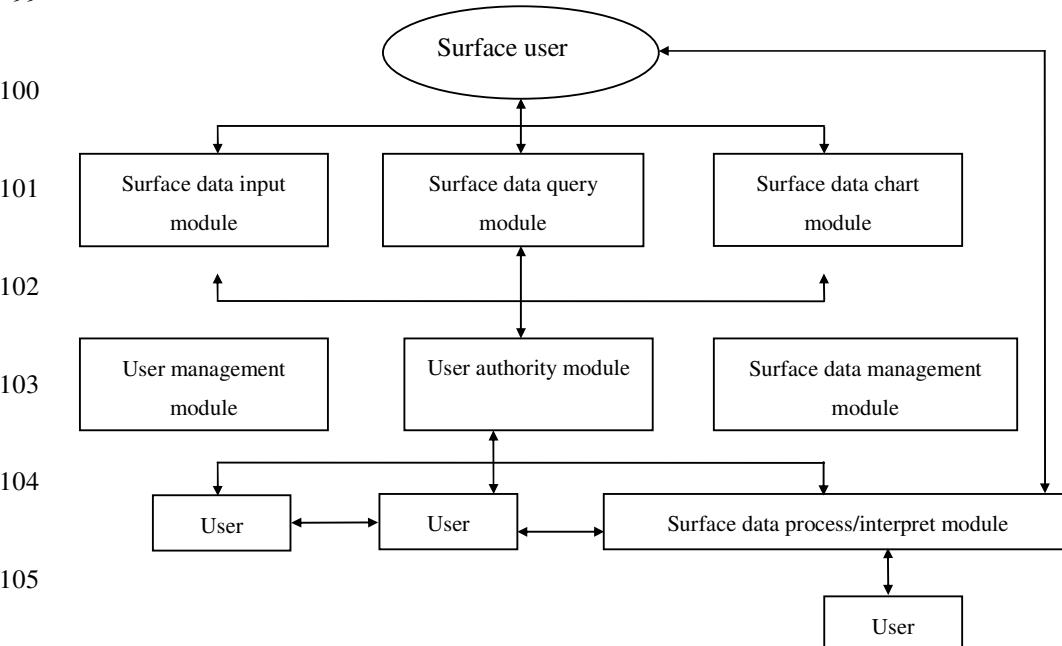
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 98 Fig. 1 System of flow chart.

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

107 **4- Key techniques to system realization:**

108 **4.1- Combination of C/S and B/S**

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

119 Considering the different requirements of outdoor production, we
 120 developed the processing/interpreting function system based on C/S
 121 architecture, because we only need to process the spot information rather
 122 than the information from other spots, where it is at most a reference.
 123 Thus one have no necessary to process other's data on his or her own spot,
 124 therefore we developed acquiring function system based on B/S
 125 architecture.

126 **4.2- Designing of input/output ports:**

127 **4.2.1 SEG 2 port**

128 This software package involves a large amount of input data.
 129 Consulting “oil gas exploration data dictionary, China petrol, (2000)”, and
 130 our own receiving instruments, both of us designed a datasheet with SEG
 131 2 port. The SEG 2 format file is the main storage method which is a
 132 binary storage frame whose internal architecture is shown in Fig. 3.

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

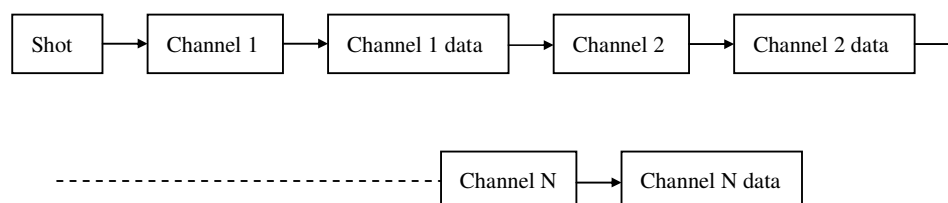
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144 Fig. 3 Internal structure of SEG2 file.

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

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

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160 **4.2.2- Designing and constructing of surface database**

161 Before this surface database is completed, there was no database
162 standard for surface experiment information in Sinopec, (Exploration
163 System Designing Group of Sinopec, 2001) “data construction and filling
164 regular for Exploration information system of Sinopec”. Therefore, our
165 surface database has been built based on the Oracle database plate, in
166 which there are eight datasheets, the seismic exploring displaying
167 datasheet, shallow refracting construction datasheet; observing system
168 and production datasheets; micro log and production datasheets;
169 unconsolidated product datasheet; lithology datasheet of surface spot.
170 These eight datasheets involve all kinds of data techniques of surface
171 framework intelligence.

172 This surface database covers the whole of the current data in surface
 173 structure intelligence (Weixiu, et.al, 2005). For security of database,
 174 especially in the surface querying system which runs through the world
 175 wide website, three measures have been taken to safeguard our data and
 176 prevent attacking from outside: Keeping strict accessing authority, only
 177 the authorized user can pass the authentication by the server. The user
 178 group has been taken as the management pattern, which authorizes a
 179 different user group for different authority, in which, server
 180 Administrator is super user and can exercise the highest right, where as
 181 the collecting user can only modify a certain spot data appointed by the
 182 server Administrator and the query data from other spots. A normal user
 183 can only browse the website. As an advantage of B/S, the normal user has
 184 an html file when any one querying the surface experiment data, but the
 185 user can not operate the server. The advantages of security of Oracle are
 186 used to fix kinds of authorities and accessing authorities to the server.

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188 **4.2.3- Transplanting from Access database to Oracle database**

189 The client database is Access database in surface experiment data
 190 processing/interpreting software package which runs fast enough that,
 191 there is no need to install a database. Hence, it is very convenient for
 192 outdoor squad. But for realizing querying function in a wide area network
 193 and compatibility with oil field database, the surface data querying

194 database is designed on Oracle which means that it needs to transplant the
195 data from Access to Oracle. Therefore a special port was designed. This
196 port is transparent to the user without necessarily knowing how much
197 does it transmits data, since he can upload data via a click of the mouse.

198 **5- The application and effect of the software**

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

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212 **5.1 The processing/interpreting system based on C/S**

213 This module runs absolutely, and it can process/interpret surface
214 data indoor or outdoor. The internal database saves, processes and
215 interprets the results, and then the output would be within a certain port.

216 This is followed by input surface data to input module, and then realizes
217 the upload to the web.

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

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223 **5.2 Surface data querying system based on B/S**

224 There are five function modules in this system which include the user
225 authentication module, the user manage module, the data management
226 module, the data input module, the data querying module and the data
227 to diagram module.

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

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

236 The data input module mainly functions in all kinds of inputting task,
237 including inputting table sheet, solid template or user-defined template,

238 which in Excel format manually inputting function, specialized data, e.g.,
239 surface data processing/interpreting module inputting.

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

245 By using the data from the database, the user can draw the types of
246 surface charts, and realize the surface data querying by the chart, which
247 include mainly the lithology histogram, unconsolidated depth plane trend
248 diagram, shallow refraction distance-time diagram, and micro log
249 distance-time diagram, and so on.

250 **6. Conclusion**

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

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