

Remote Laboratory Data Management System Based on LabVIEW

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Abstract—In view of the deficiency of most of programming tool in connecting a professional database and manipulating data difficultly, a method is applied to realize the exchange visits between LabVIEW and database, and actualized the exchange visits. Tested by experimentation, the method can provide both students and administrators with an easy to learn, easy to use system that, through automation and web technologies, allows the laboratory to be run with out the need for notebooks, printouts, or other types of paper administration. Students in these classes will have the opportunity to analyze real-world data from a facility that they have worked in or may easily visit and observe. It has been applied in our laboratory successfully and proved operating easy and responding quick. The general, flexibility and security of the laboratory management information system are very well.

Keywords—virtual instrument; database; remote laboratory; data management system; LabVIEW

I. INTRODUCTION

College of Electronics and Information, under the auspices of the Xi'an Polytechnic University, has developed a remote control laboratory provided perform experiments via the internet for students. The estimated throughput is approximately 2000 students per semester. Because of this large number of students, and a resultant large amount of information associated with processing and test data, a system for managing both the day-to-day operations of the facility and a system to track all data collected was required.

Virtual instrument is a National Instruments company first proposed the innovative concept of LabVIEW in their products, with the modern testing technologies and instrumentation technology development, at present the concept of virtual instrumentation has evolved into an innovative instrument design ideas for design and testing of complex test systems instrument main methods and means. The face of a lot of data whether it is manual data management or file system management can not properly reflect the close links between the various types of data, are not effective management and organization of data. Therefore, database-centric, data-management focus, Construction of a database management data based on virtual instrument system is the modern trend of test and measurement system development [1]. Its structure diagram is shown in figure 1.

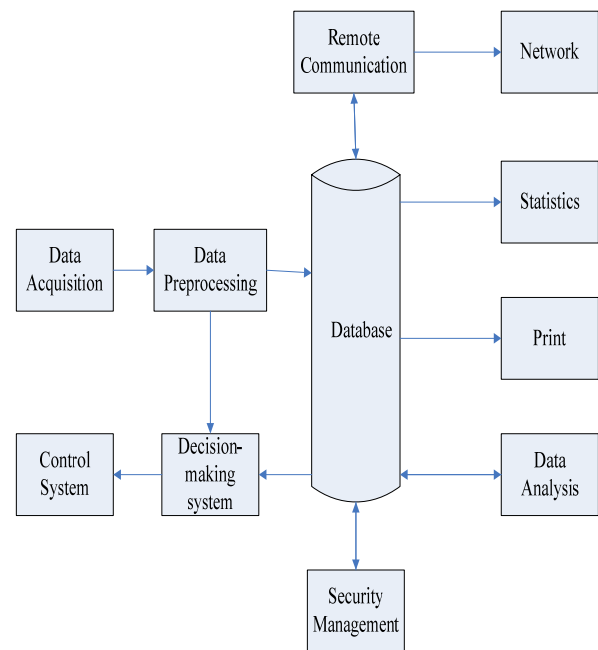


Figure 1. Test platform system block diagram based on the database

The laboratory information management system is a lab automation workstation that uses the remote control laboratory. At Xi'an Polytechnic University, it is used in a course, PCI-5110 Data Acquisition and Laboratory Automation, to demonstrate the fundamentals of remote control laboratory. This system has been engineered to function with National Instrument graphical software program LabVIEW. LabVIEW is an excellent tool for information management. Based on changing conditions, it is able to dynamically use data from any source to modify the operating parameters of an experiment. For dynamically changing information, storage of that information must be readily accessible. For example, there is a need to continuously store and update the data of the experiment, and also store experiment information. This can be achieved by using a database which allows for experimental data to be easily searched and accessed. To address this need, an interface was developed which would allow full, dynamic communication between any LabVIEW program and the database. This has been accomplished by developing a set of subVIs that can be dropped into the calling experimental control VIs. With these subVIs, a user has the ability to create table and column information, delete a table, retrieve table information by clicking a particular table name on the user interface, or query using any SQL-specific combination

of columns or tables within the database. For experiment functionality, subVIs were created to store and retrieve data such as calibration data points and regression calculations.

II. SYSTEM DESIGN

A data management system is an essential part in virtual experiment system design, which is responsible for user permissions settings, user registration, user records, as well as detailed information on the system administrator of the virtual experiment system management and so on. While LabVIEW itself does not have access to database function, must design the communication between LabVIEW and database interface.

A. Database Interface

Computerized instrumentation allows measured data to be stored for off-line processing, or to keep records as a part of the record [2], [3]. There are several currently available database technologies that can be used for this purpose, File System, Extensible Markup Language (XML), Open Database Connectivity (ODBC), Java Database Connectivity (JDBC), ActiveX Data Objects (ADO) and Data Access Objects (DAO). Simple usage of file systems interface leads to creation of many proprietary formats, so the interoperability may be a problem. The Extensible Markup Language (XML) may be used to solve interoperability problem by providing universal syntax [4]. The XML is a standard for describing document structure and content [5]. It organizes data using markup tags, creating self-describing documents, as tags describe the information it contains. Contemporary database management systems such SQL Server and Oracle support XML import and export of data [6]. Many virtual instruments use Database Management Systems (DBMSs) [7]. They provide efficient management of data and standardized insertion, update, deletion and selection. Most of these DBMSs provided Structured Query Language (SQL) interface, enabling transparent execution of the same programs over database from different vendors. Virtual instruments use these DBMSs using some of programming interfaces, such as ODBC, JDBC, ADO, and DAO [8].

The LabVIEW Database Connectivity Toolset is owned by National Instruments. It originated from an older toolkit known as the SQL Toolkit created from a code of interface node (CIN) that links to a chain of Dynamic Link Libraries (DLLs). "These DLLs made system calls into Microsoft's application programming interface (API) for database access called ODBC." The Open Database Connectivity (ODBC) was created by many entities (SQL Access Group, Microsoft, Tandem, Oracle, Informix, and Digital Equipment Corporations), as the standard form to access databases. The major drawback of ODBC is that it works only on relational databases. Microsoft saw the potential in creating a standard format that accesses both relational and non-relational databases and thereby created Universal Data Access (UDA) which links various data types from any application or data stores. Object Linking and Embedding Database (OLE DB) implements UDA. ActiveX Data Objects (ADO) is the application-level programming layer between the program

language and the database [8]. For example, figure 2 as shown ODBC OLE DB Provider's communication pathway between ADO and a database.

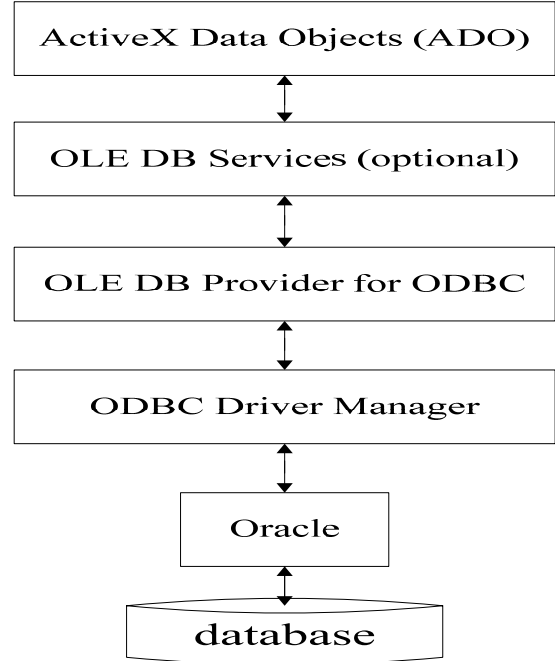


Figure 2. ODBC OLE DB Provider's communication pathway between ADO and a database

B. User Registration Module Design

User Registration module can be used to register basic information about students and to provide students with a user name and password access to virtual experimental system. The student will be asked to use their Student ID to register a new user before access to Virtual laboratory, the user interface for registration as shown in figure 3. After entering the virtual laboratory registered click button, then fill in relevant information, the system will automatically detect whether or not to repeat and then successfully registered personal account, student can use the password set up registration, visit the virtual experiment system.

The "submit" button is responsible for submission of registration information to the database. In order to avoid the user to direct click on the "submit" button under the premise of view in the absence of the availability of its student ID No., so that its database duplication of learning, the program in the "submit" at the same time, an increase of auto-detection, if the student ID No. haven't repeat, it show that "Registration success", on the contrary show that "you can not enter the system, please re-enter." In addition, the procedures for school-digit number and scope of restrictions, if the study the median number is not provided for in the system or outside, it shows "You have entered an incorrect number of places, please re-enter."



Figure 3. Register interface

C. Landing Module Design

Landing module is a virtual laboratory to verify the security module; it is a very important part of system resources in a virtual experimental system design and is an important link to ensure that system resources are not undermined. The system uses a common authentication. The first time students visit the virtual experiment system administrators will be asked to submit their personal information when students register to the database, as shown in Figure 3, and the user name is student ID No. Password is set by the students themselves. After receiving certification students can modify their password, enter the system can also carry out such experiments. Landing Interface shown in figure 4, after a successful landing as shown in figure 5, entered into the system can be seen dynamic display and the virtual laboratory of the installation of the experimental procedures and experimental interface.



Figure 4. Landing interface



Figure 5. Remote laboratory experiments Interface

Landing procedure involves the user authentication, password modification, as well as access to the experimental system and so on; need to consider more details, background process more complicated. Identity which relates to database query operation in order to enter the user name and password-based query elements, one by one in the database search, the final output of the query results, and to deal with query results. Password modification relates to modify the password and new password to the database, such as write operations modify password operation here as an independent subVI, write a new password to the database is used to update the database information. And access to a virtual experimental system is relatively simple, it can direct call subVI. The overall flow chart of the landing interface as shown in figure 6.

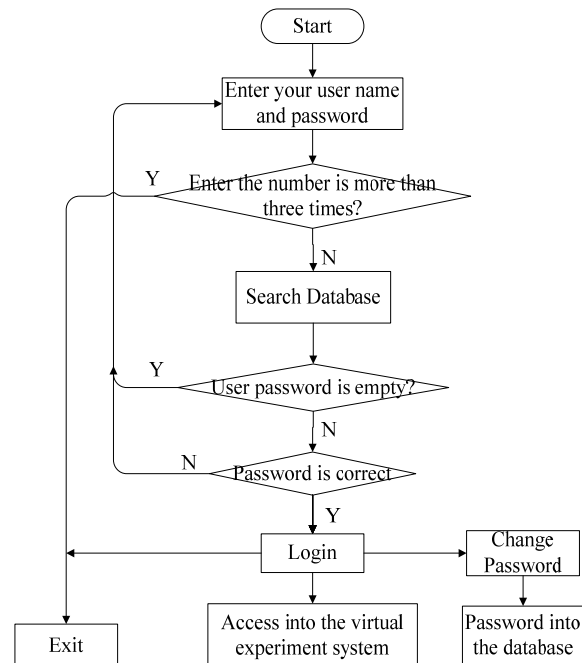


Figure 6. The flow chart of the Landing interface

III. CONCLUSION

The results demonstrate the utility of LabVIEW to allow access to a database for laboratory management system. The user is able to create, delete, or view the existing tables in a database from the front panel interface in LabVIEW. The List Create Delete.vi is a valuable tool to those persons who are not familiar or comfortable with database(s). The user is led from one subVI to another by simple instructions. There is also an error checking method to remind users to always enter a file path. Overall, the system is a good tool for storage and retrieving of information. The user has the ability to manipulate the database without necessarily understanding the details of the implementation. The main goal of this project to create an interface between LabVIEW and the database has been achieved. This has been achieved by using a database to allow easy search and access for any data needed for remote laboratory management.

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