Conclusion

We will summarize the steps fulfilled in defining the profile for documenting the infBM process. On the first place, we have identified the components of the framework for representing the infBM process, i.e. the profile for infBM, and the profile for the process of infBM. Then the profile for the process of infBM has been defined, which was an important target of ours. This profile emerged on the basis of the SPEM profile, and was driven by our thesis for semantic correspondence between the profile for the product and the profile for the process of infBM. Afterwards, the profile for the infBM process has been transformed into a profile for its documenting, regarding the requirements to the model of the infBM process. Using this profile, we have made some experiments to represent the process of infBM. More precisely, we have built up the infBM workflow model and its subprocesses have been specified by the template defined for the purpose.

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DEVELOPMENT OF DATABASE FOR DISTRIBUTED INFORMATION MEASUREMENT AND CONTROL SYSTEM

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Abstract: The purpose of this work is the development of database of the distributed information measurement and control system that implements methods of optical spectroscopy for plasma physics research and atomic collisions and provides remote access to information and hardware resources within the Intranet/Internet networks. The database is based on database management system Oracle9i. Client software was realized in Java language. The software was developed using Model View Controller architecture, which separates application data from graphical presentation components and input processing logic. The following graphical presentations were implemented: measurement of radiation spectra of beam and plasma objects, excitation function for non-elastic collisions of heavy particles and analysis of data acquired in preceding experiments. The graphical clients have the following functionality of the interaction with the database: browsing information on experiments of a certain type, searching for data with various criteria, and inserting the information about preceding experiments.

Keywords: Database of distributed information measurement and control system, database management system Oracle9i, distance learning.

ACM Classification Keywords: H.2.8 Database management: Database Applications

Introduction

Automatization of scientific research and use of software-driven modular electronics significantly simplify experimental work making it less time-consuming and more accurate. However, a database of an experiment appears to be a non-negotiable condition for data logging, ordered storage and user-friendly maintenance.

The aim of this work was to develop a database for distributed information measurement and control system that would implement methods of optical spectroscopy in atomic collisions and plasma physics as well as provide a remote access to its resources across the Intranet/Internet.

Distributed Information Measurement and Control System

A distinct feature of the distributed information measurement and control system is that it allows combining different device interfaces along with their control computers into uniform network functioning on the basis of TCP/IP.

The distributed system is built as a centralized system [Gavrilov et al., 2003] – [Kiprushkin et al., 2006]. The structure scheme is presented in Figure 1.

The system is comprised of the following parts: the communication (central) server; the equipment servers (CAMAC server, GPIB server, the server of Intel MCS-196 microcontrollers, Ethernet devices server and the server of access at GDS-840C digital oscilloscope et al.); the client programs fulfilling the collection, accumulation and processing of information and experiment control; the universal protocol connecting the communication server with the equipment servers; and the extended protocol connecting the communication server with the client programs.

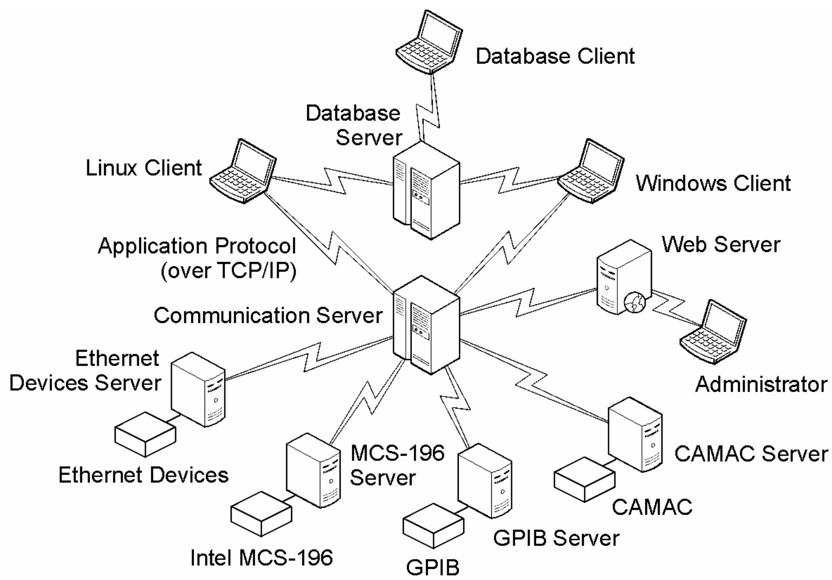

Figure 1. The scheme of the distributed information measurement and control system

The distributed information measurement and control system is based on the modular approach implemented both in the structure and in the software. Clients and equipment servers are built into the system according to the unified rules and interact on a unified protocol by the principles of open systems. Note that an open system is a system that implements open specifications or standards for interfaces, services and formats in order to provide software portability with minimal changes in a wide range of systems (mobility) as well as interaction with other applications on local or remote systems (interoperability) and users (user mobility) [James et al., 1994]. In particular, distributed systems are based on OSE/RM model that describes systems by client/server architecture.

The distributed system was written in Java language – an object-oriented programming language, its platform-independent programs run similarly on diverse hardware with Java virtual machine. Along with this, web-technologies were widely used, too.

Administration of the distributed system is based on server-side Java servlet. Using the servlet started up on the Web-server, a system administrator logins to the communication server as a privileged user. S/he monitors resources of the distributed system, may deallocate resources and disconnect clients. The system administrator grants clients' access rights for the equipment servers, ensures unique client and server identifiers, and maintains public-key database of all parts of interconnection.

Note that a communication server of the distributed information measurement and control system is only a moderator between the equipment servers and the client programs that collect, accumulate and process data. That is, its main function is to maintain multiuser mode and correct allocation of resources among clients, to monitor and to protect the system. Therefore, there is a direct client program-server interaction bypassing the central server. More than that, the latter has no information on the type of the current experiment.

Database of Distributed System

Currently, the most popular database management systems (DBMS) are Borland Interbase, Oracle, MS SQL Server, MS Access and MySQL. Chosen DBMS Oracle9i, namely Intel Pentium 4 compatible Oracle 9.2, perfectly meets such crucial criteria as protection of data integrity, administering capabilities, crossplatformness, guaranteed data storage and recovery, capability to work with large amounts of data, and Java language support [http://www.oracle.com; http://asktom.oracle.com].

Practically, Oracle DMBS works as a broker between the database and its users. Oracle server is a high-speed multithreaded multiuser SQL server. It can serve high-load critical production systems as well as mass software. The server authorizes clients' access to the database, processes queries and sends information back to clients, or informs them if an accidental error occurs.

When a client sends the data, DBMS verifies if this client is authorized to write the data. If authorization is valid, the server registers it in the database and sends a confirmation back to the client. If access is denied or an error occurs in data write (or transfer), the client receives a notification. It is important that only the core has an access to all data in the database, client applications never write any data directly in the database.

The software for database clients was developed using Model View Controller Architecture (MVS) that separates application data of the model from graphical presentation components and input processing logic (controller).

The following graphical presentations were implemented: measurement of radiation spectra of beam and plasma objects, excitation function for non-elastic collisions of heavy particles and analysis of data obtained in proceeding experiments. Developed client programs manage the course of the experiment by interacting with the equipment servers through the communication server and transferring acquired data to the database. The graphical clients have the following functionality of the interaction with the database: browsing information on experiments of a certain type, searching for data with various criteria, and inserting the information on proceeding experiments.

The developed database stores outputs of the following experiments: measuring optical spectra of plasma objects, excitation spectra of atomic-atomic and ionic-atomic collisions, cross-sections of spectral line excitation with fixed collision energy along with dependence of excitation cross-sections on energy of colliding particles. The data is stored in corresponding tables with Java access. Java Database Connectivity (JDBC) API supports interaction with DBMS Oracle9i. Tables are created using Java utility.

Tables are bound by means of certain relations. This provides the possibility to combine them in a single query. The most frequently used tables are as follows: a table of users and their rights, a table of initial experimental parameters, tables for each type of an experiment where experimental data is logged.

In the distributed system, each part of net intercommunication can login to the database with a unique username and a password. The system administrator registers DBMS users and grants or revokes access at four privilege levels: global, database, table, and column.

The software was implemented using J2SE Development Kit v5.0 and development environment NetBeans 4.0 [http://java.sun.com]. A well-designed interface ensures effortless implementation of graphical applications with NetBeans 4.0 tools. A significant advantage of NetBeans is that this environment is produced with the components that allow working with Oracle DBMS using its own API, which provides high-speed data traffic.

Implemented software was assembled into a software complex for Windows operating system with the help of Excelsior JET 3.7 packet. This packet is user-friendly – it automatically installs JRE 1.5, JDBC-Think driver, creates shortcuts on the desktop and in the Programs menu.

Conclusion

The implemented database contributed to the organization of data storage, provided easy and quick access to experimental results, which simplified data processing and analysis of obtained results. The data is available online to researchers from all over the world and can be used as a tool in distance education.

It is necessary to point out that the developed database of distributed information measurement and control system is used for the beam and plasma object analysis with the help of optical spectroscopy methods. In particular, the researches on excitation processes of atomic collisions with inert gas atoms' participation are carried out with its help as well as the laboratory works with senior students of Department of Physics and Engineering of Petrozavodsk State University.

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