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The implementation of measures for reduction an inertia of the interaction components of the heterogeneous environment for the automated process control system

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Abstract. Authors have proposed the model of a specialized data management system in the automated process control system. This model is proposed by based on the results of research into the interaction of heterogeneous systems, as well as trends in the development of information support. The software instances, information support, and the interface of their interaction are considered. The implementation of measures for reduction an inertia of the interaction components of these types of a software by applying the formation transactions approach are suggested. The implementation of measures is connected with a revision of an algorithmic essence of the heterogeneous environment components of the automated process control system is expressed by organization of connections pool, which based on using ODBC API functions and the exclusion of gateway transport. The numerical effect of these measures were a reduction the inertia of an inertia of the interaction components of the heterogeneous environment of the automated process control system.

1. Introduction

In this article after using the resource potential of the developed simulation model, the measures were implemented for reduce an inertia of the interaction of the components of the heterogeneous environment of the automated process control system [1].

The implementation of an iterative approach to the formation of transactions is expressed in the construction of a specified set of transactions that meet the principles of mono-commandness, monoargmentity and mono-consistency [2].

The SCADA system considered as an instance of software permits to automate the process of interacting with the DBMS by preliminarily building a set of transactions in the query browser (Figure 1), saving, subsequently indexing and further applying transaction indices in the subroutines to access the saved transactions during the recalculation of the channel database [3].

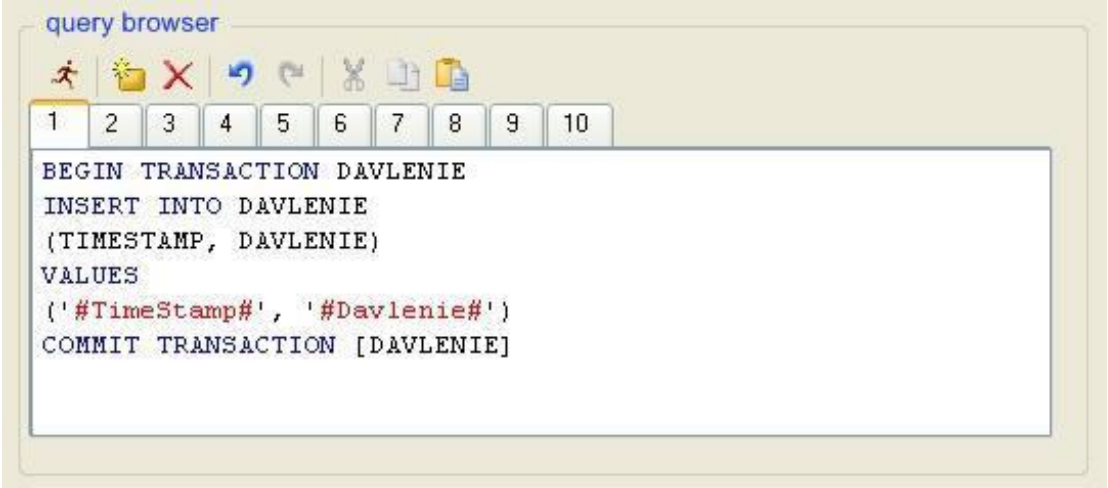

Figure 1. Building a specified of the transactions set in the query editor SCADA-system.

An example of the data entry of channel recalculation records is given:
PROGRAM
VAR_OUTPUT (Database)_1_196_In : REAL; END_VAR
Database_1_196_In=1;
END_PROGRAM

The implementation of measures is connected with the revision of the algorithmic essence of the interface of the interaction of the components of the heterogeneous environment of the automated process control system is expressed in the organization of the connection pool based on the use of ODBC API functions [4], also in the exclusion of inter-network transport.

The connection pool implemented in this work is possible due to the preliminary specification of transactions set by applying an iterative approach and organizing calculations within the decentralized data management model “many to many”, while the interaction of the components of the heterogeneous environment of the automated process control system within localhost.

One way to the ODBC activate of the connection pooling mechanism organization is using the Connection Pooling tab of the ODBC Data Source Administrator toolbar (ODBC Data Source Administrator) version 2.3 or higher.

In this case, the interaction of the heterogeneous environment components the automated process control system via the ODBC interface is performed in the following sequence of API function calls:

- Enable connection pooling by calling a function SQLSetEnvAttr with environment attribute SQL_ATTR_CONNECTION_POOLING, equal to SQL_CP_ONE_PER_DRIVER or value SQL_CP_ONE_PER_HENV. When the SQLSetEnvAttr function is called, the environment descriptor sets to NULL, which defines the SQL_ATTR_CONNECTION_POOLING attribute as a process level attribute.

- Creating an environment descriptor by calling the SQLAllocHandle function with a descriptor type parameter value equal to SQL_HANDLE_ENV, while the environment created is implicitly shared environment;

- Creating a connection descriptor by calling the function SQLAllocHandle with the descriptor type parameter value equal to SQL_HANDLE_DBC. The driver manager will search for the existing the shared environment with the corresponding environment attributes (if the required environment is found, it is returned to the application (SCADA system) and the driver manager increases the counter value by 1). If there is no such environment, the driver manager creates it and sets the counter to 1;

- To obtain a connection from the pool, the SQL Connect function calls. Manager drivers uses the parameter values and connection attribute values to determine the desired connection from the connection pool. This takes into account the value of the SQL_ATTR_CP_MATCH attribute (matching the desired connection to the connection from the pool);

- The call of SQLDisconnect function carried out for disconnect of connection. In this case, the connection is returned to the pool and has become available for further use.

Some information about whether the driver manager's attempts to set a connection after turn on a connection pool is stored in the MS Windows registry:

HKEY_LOCAL_MACHINE
Software\Odbc\Odbcinst.ini
ODBC Connection Pooling\Retry Wait

The implementation of the connection-pooling mode within the framework of a simulation model for studying the interaction of components of a heterogeneous process control system permits the SCADA system to select connections from the pool without having to re-install them for each use. Thus, the time for setting and break the connection reduces.

Figure 2 shows the UML diagram of connection fix sequences between the components of the heterogeneous environment of the automated process control system via an ODBC interaction interface located on remote hosts separated by a communication network.

The elements of the UML diagrams marked in red clearly and demonstrate the transitions between the modules of the heterogeneous environment of the automated process control system that participate in the interaction and the time segments spent on the implementation of the group of operations. The marked time periods will be possible to reduce when implementing the connection pool mode and excluding the network transport procedure.

The exclusion of the network transport procedure in this paper are implemented by organizing a one-level interaction of the components of a heterogeneous environment in particular SCADA and DBMS within localhost. This circumstance will allow not using the communication network, when organizing transactional calculations, and, therefore, to avoid the method of tripartite handshaking of the TCP / IP protocol stack and the resulting time delays.

According to the result of the implementation of measures aimed at reducing the inertia of the interaction of the components of the heterogeneous environment of the automated process control system. Within the framework of the simulation model of this work, the transaction was carried out at the stage of starting the life cycle of a regulated flow of the technological process.

Table 1. Inertia Parameters.

Perforation depth, $P_{\Delta t}$, c	Number of perforation zeros, P_0	Number of punching units, P_1
2	49	207

According to the method, the values of the inertia parameters of the interaction of the components of the heterogeneous environment of the industrial control system of the technological process are redefined (table 1).

The analysis of the obtained values permits us to conclude that the implementation of an iterative approach to the formation of transactions and the implementation of measures to reduce the inertia of interaction showed an increase in the ODBC interface performance by 12.5%. In this case, the inertia of the interaction of the components of the heterogeneous environment decreased from T_{in}= 1,22 second to T_{in}= 1,19 second.

The model of a specialized DBSM permits to ensure priority in the execution and asynchronous nature of requests by applying a predetermined algorithm for performing transactions and eliminating the method of three-way acknowledgment of the TCP / IP protocol stack. The model is focused on operating data in the main memory of nodes of a locally distributed GRID system, however, unlike the in-memory table technology [5], the operation procedures provide not only full loading of database tables into the main memory, but also their permanent storage there.

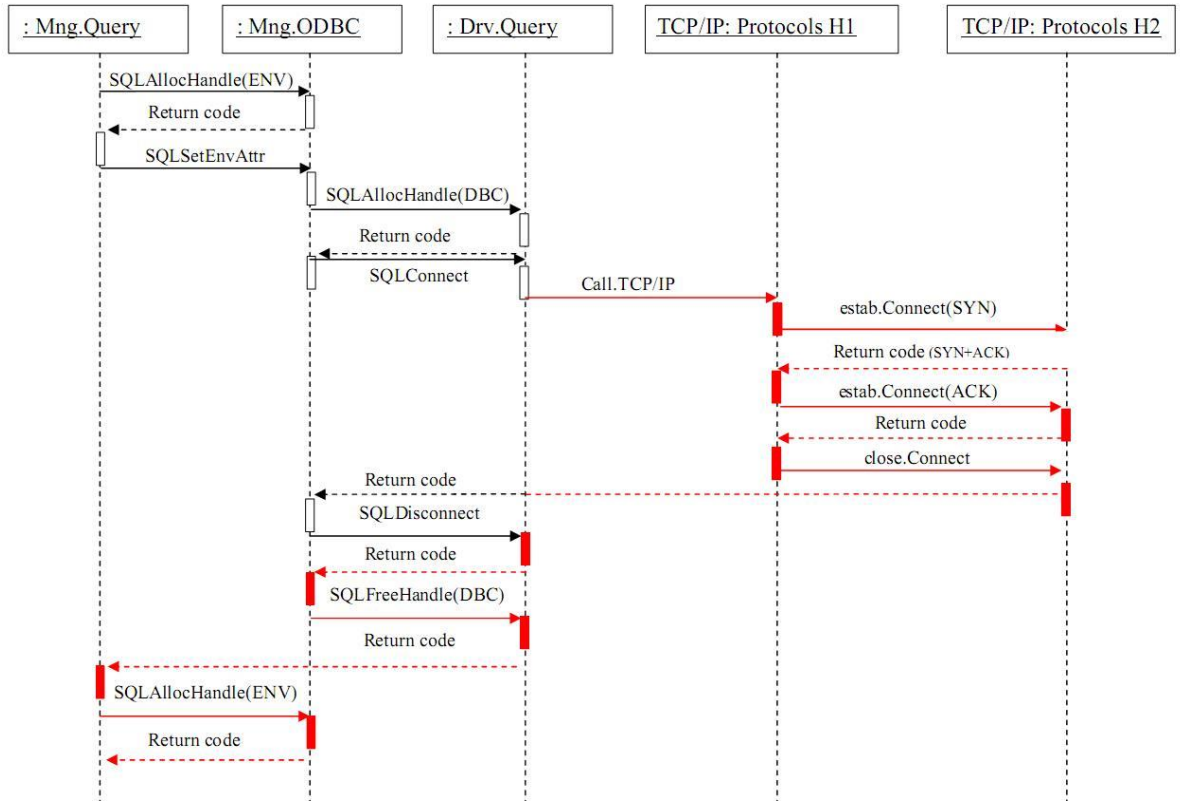

Figure 2. UML - diagram of the sequence of fixing a connection within a SQL query session.

The expected result is expressed in increasing the performance of calculations when implementing a model of a specialized DBSM, and it reflectes the results of research in the field of performance of universal DBSM. According to a orientation on disk memory reduces the performance of calculations to 35%. Thus, the implementation of the model will reduce the inertia of the interaction of the components of the heterogeneous environment of the industrial control system from T_{in}= 1,19 second to T_{in}= 1,10 second. The technology of organizing specialized information and software distributed process control systems is aimed at improving the performance of heterogeneous environment components. It does not meet the hard real-time specifications, and allows us to approximate the time of operating the data of the chain of components of the heterogeneous environment of the process control system to real-time mode.

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