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COMMUNICATION STANDARDS SUITABLE FOR MES SYSTEMS DESIGNED FOR SMEs

KOMUNIKAČNÍ STANDARDY VHODNÉ PRO SYSTÉMY MES, NAVRŽENÉ PRO MALÉ A STŘEDNÍ FIRMY

Abstract

A MES (Manufacturing Execution System) is a system that large companies use to measure or control critical production activities. Individual parts of this system can be used as a model for development of tools suitable for small and medium enterprises (SMEs). It can demonstrate how manufacturing systems works and which communication standards are usable. The communication standards enable data acquisition, data processing, storing and their conversion for any production report. Furthermore, interfaces for web clients allow displaying the raw or transformed data as a text or a graphic chart. The development of tools for an access to the data retrieved from MES software is described in this paper.

Abstrakt

Systémy MES (Manufacturing Execution System) jsou využívány společnostmi pro měření a řízení kritických výrobních činností. Jednotlivé části zmíněného systému lze využít jako model pro vývoj nástrojů specifických pro malé a střední firmy. Lze využít principy, jak průmyslové systémy pracují a komunikační standardy, které se pro tento účel hodí. Komunikační standardy umožňují měření a následný sběr výrobních dat, jejich zpracování, ukládání a konverzi na jakýkoliv druh reportu. Navíc s použitím rozhraní pro webové prohlížeče lze zobrazovat „surová“ data z výroby nebo přepočtené, konsolidované hodnoty jak v textové podobě, tak i ve formě grafu. V tomto příspěvku je popsán proces tvorby jednotlivého nástroje MES systému.

1 INTRODUCTION

MES (Manufacturing Execution Systems) sometimes called as CPM (Collaborative Production Management), are used for measuring and controlling of company production. When company implements this system correctly, its productivity and quality of production will increase, because for production data it is very important to process and validate them in the way, which MES systems offer. Fig. 1 represents a classical structure of company information systems.

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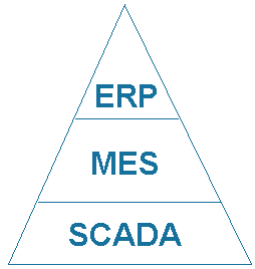

Fig. 1. Company information systems structure

MES system is reading real time data from processing systems and saving them into archive. These data are validated, converted and aggregated. During aggregation data size is reduced. After this procedure data are prepared to be transferred into superior system (ERP systems, for example).

2 USE OF COMMUNICATION STANDARDS

Communication standards which are used in MES systems must be chosen very carefully, because these standards define system accessibility, stability and security. Company information systems are usually using communication standards on three levels. First level represents interface between processing systems and MES system itself, second level represents communication between MES system and databases and last, the third level is between databases and ERP systems or presentation environment. In a following text standards are described which represent layers and fulfill requirements of MES systems.

2.1 OPC

For real time data acquisition OPC (OLE for Process Control) standard can be used, more precisely OPC DA (OPC Data Access). This standard is based on OLE COM and DCOM technologies. This specification defines a set of standard objects, interfaces and methods for production applications. In this time a new version of OPC is available, namely OPC UA (United Architecture). OPC UA is optimized for web services and is simpler and more secured than old versions. OPC standard fulfill requirements for first level of information systems.

2.2 ADO.NET

ADO.NET is a pack of software components which are used for data access or data services access. These components are implemented in Microsoft .NET framework. This standard has many advantages, like usage in offline applications; it supports many programming languages or an access to data in different data sources. ADO.NET is mostly used for access to all databases types or to data access via web services. This standard is useful for a second and third layers of mentioned information systems.

3 CREATING SIMPLE MES SYSTEM

For development purposes it is useful to create a simple MES system which will use all mentioned standards and will fulfill basic MES functionality. On this simple example the meaning of data in MES systems and practical usage of communication standards in these systems is presented. For simplicity is better to choose Windows platform.

First step of creating a simple MES system is defining real time data source. As the real time data source Matrikon simulating server can be used. This data source will simulate real data from manufacturing processes.

3.1 OPC client

When we have chosen a suitable data source, we have to create a program to reading and storing these data. Program will work with OPC DA standard. Our real time application program will read data by using OPC DA from Matrikon simulation server, display these data on the screen (monitor) and save them into database by using ADO.NET. Database can be MSSQL version 2005 or higher (relation database type is recommended). Functionality of this program will be simple: by clicking on "Connect" button a procedure of connecting to the simulating server will start and real time data will be read. Real times data are displayed on the screen and saved to the database with own timestamp (reading time). These simulating data can represent nitrogen and dust concentration for example.
Fig. 2 represents possible design of OPC reader screen.

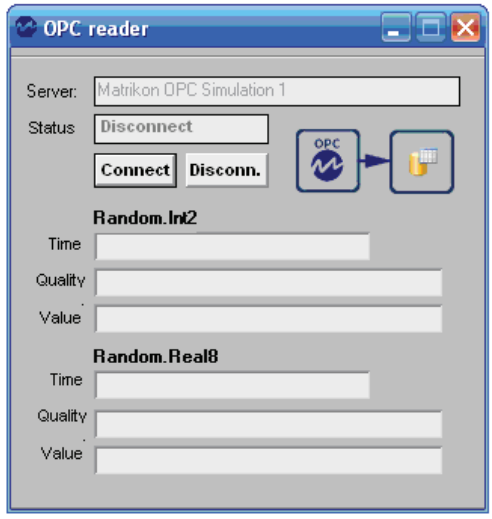

Fig. 2. OPC reader screen

3.2 Real time data updating

Because in MES system data aggregation is very important, we have to create windows service to data re-computing as a second step. Re-computing means data conversion to statistic values like maximum, minimum, averages or a standard deviation etc. Data in this form are useful for managers or workers with decision making authority. Windows service will read real time data from database by using ADO.NET and re-compute them to statistic values in specific period. This period can be every hour for example. Converted data will be saved back to the database by ADO.NET standard. Windows service can be started automatically or manually.

3.3 Data presentation - web application

Data presentation is not less important. Most suitable form is data presentation by using web applications. The reason is simple: web applications are accessible from many places and you don't need to install special software. You only need connection to internet. We can present real time data or statistic data as well. Both choices are advisable because of data meaning - real time data are useful for service workers and statistic data for managers. Presentation of these data can be carrying out by two techniques. First technique is displaying data in text form (values), second technique is displaying data as figure. Both techniques are essential. Text form can show us exact numbers which are important for data verification, graphical form (figures) will show us better overview about production data in selected period. Fig. 2 and 3 present possible data output (text and graphical forms). As we suggested before, web application will read real time and statistic data from database by using ADO.NET standard. Data to the text output will be shown on tables and data to graphical

output can be painted by a common class which we can program by our self. Very important functionality in this kind of web applications is data updating. Sometimes errors can occur (in production systems) and you will get wrong data to the database. To handle this situation you must have the possibility to change wrong values.

From	To	AVG	Max	Mix	Integration	
9.9.2007 8:00	9.9.2007 9:00	143,0751	150,9284	136,0222	523260,6	Change
9.9.2007 9:00	9.9.2007 10:00	154,4896	162,4736	143,4229	565005,9	Change
9.9.2007 10:00	9.9.2007 11:00	160,8745	164,1594	154,9104	588858,6	Change
9.9.2007 11:00	9.9.2007 12:00	159,0548	169,2989	152,2425	581854,9	Change
9.9.2007 12:00	9.9.2007 13:00	165,8396	172,574	159,0005	607253,9	Change
9.9.2007 13:00	9.9.2007 14:00	138,4117	161,6281	113,9434	507923,3	Change
9.9.2007 14:00	9.9.2007 15:00	112,2169	117,2824	107,2678	410838,6	Change

1 2 3 4 5

From	To	AVG	Max	Mix	Integration	
9.9.2007 8:00	9.9.2007 9:00	143,0751	150,9284	136,0222	523260,6	Change Cancel

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Fig. 3. Web application data output in text form

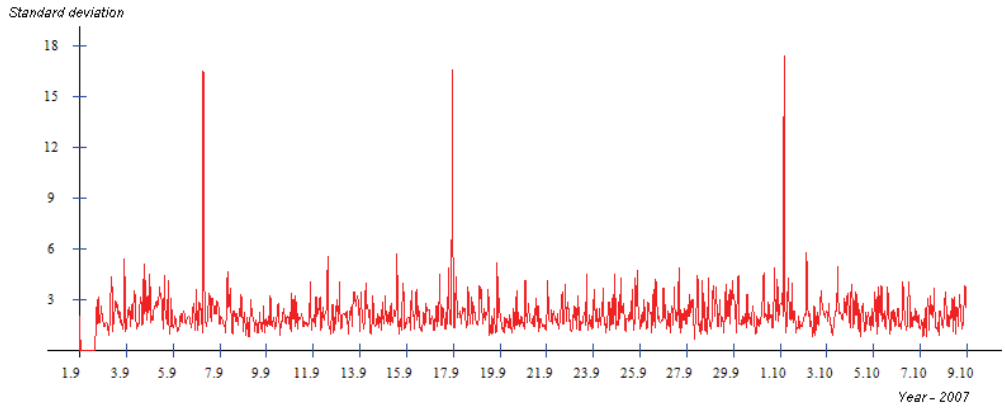

Fig. 4 Web application data output in graphical form

Web applications with this kind of data have to be secured. For this purposes .NET security provider can be used which is implemented in .NET Framework. .NET security provider offer quite good landscape for programming and is easy to use. The end users don't have to program theirs own security provider.

3.4 Data presentation - web service

Additional feature of MES systems can be web services. Web services are on the rise recently. It is a very simple and stable method how to provide data to end users (customers). By using web services production or statistic data can be displayed with same output (text and graphical forms) as on web applications. Big advantage of web services is that end users don't have implemented complicated classes for data reading. They will only append few rows with programming code to their web sites and they will be able to use web service. Manipulation with data is almost the same as in web applications, the difference is only on the input - data are received in XML format by using ADO.NET standard. Our web application (mentioned in point 3.3) can contain web service class

which will work up data to XML and send it out to web service reader. Web service reader will be basically a web application too, only difference will be in data input. Functionality will be the same (data displaying and updating). As mentioned earlier, every application with this kind of data have to be secured. Our web service reader can be secured by the same security provider as a web application. Same users will be able to login. This functionality will be implementing logon tickets. Each user will get own ticket after successful login and with this ticket will be able to browse application and see all data. Ticket verification will be proceeding on web application server (no on web service reader server).

4 CONCLUSIONS

This article deals with communication standards in MES control systems. Main point of this work is to show the end users in small and medium companies how easy is to work with real production systems and how it can practically implement communication standards in these systems. For practical purposes a sample MES application was created and described which meets with all requirements. Fig. 5 represents overview about all functionalities implemented in our MES system.

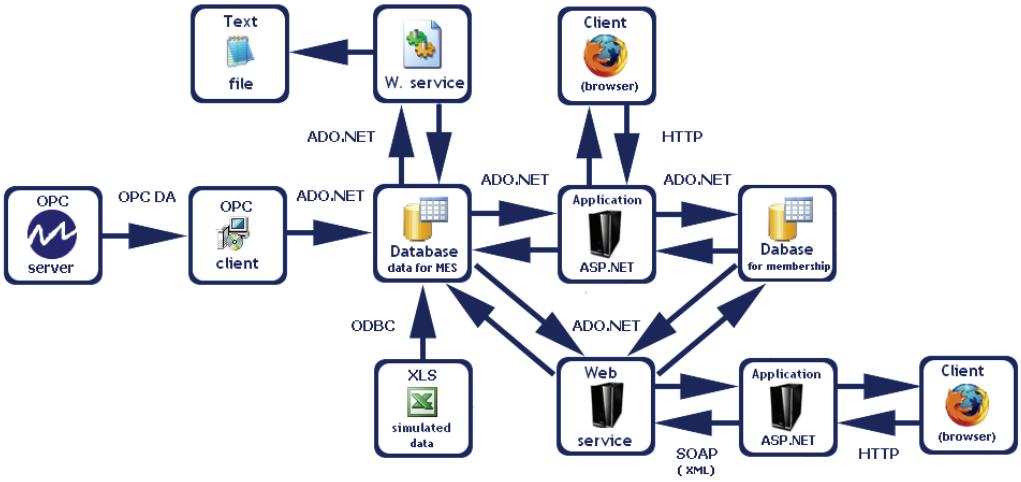

Fig. 5. MES system overview

OPC client reads real time data from Matricon simulating server by using OPC DA standard. These data are stored in SQL database with their time stamps by using ADO.NET standard. Every hour data is red from a database by Windows service, which is re-computing these data to statistic values. These processed data are saved back to the database. Statistic values and real time data are presented on a secured web application by text or graphic form. Authorized user can change wrong values. Last part of this system is a web service. By using its functionality users can simply read real time or statistic data from a company production and they don't need to program complicated classes for data reading. If the end users understand a structure of this example and implementation of a process, they will be able to operate it with various production systems in their practice live.

ACKNOWLEDGEMENTS

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