INFORMATION SYSTEM FOR BOTTLE CONVEYERS

Stanimir Damyanov Mollov[1], Slavy Georgiev Mihov[1], Stoyan Nikolov Jilov[2]

[1]Faculty of Electronic Engineering and Technologies, Technical University – Sofia, 1797, Sofia, Bulgaria, phone: +359 2 965 32 69,e-mail: smollov@abv.bg, smihov@abv.bg
[2]SPV Ltd. Rakovsky 135, 6000, St. Zagora, Bulgaria, e-mail: spv@abv.bg

Information-control systems combine functions of control with capabilities of collecting and manipulating data. Series of reasons stimulate the development of private information-control systems for meeting the specific needs. The present paper introduces an information system, developed for the purpose of facilitating industrial conveyers' control. The developed environment for collecting technological data, adjustment and diagnostics of industrial controllers is based on previously defined protocol for communication between stations in industrial area network. The software part of the information system is developed through the Integrated Development Environment (IDE) Microsoft Visual Studio 2005 which supports .NET technology for software development and possesses all its benefits.

Keywords: industrial controllers, cross-interface transformer, information system

1. INTRODUCTION

The present paper introduces an information system, developed for the purpose of facilitating industrial conveyers' control and particularly beverage lines. The structural scheme of such a line is shown on fig. 1.

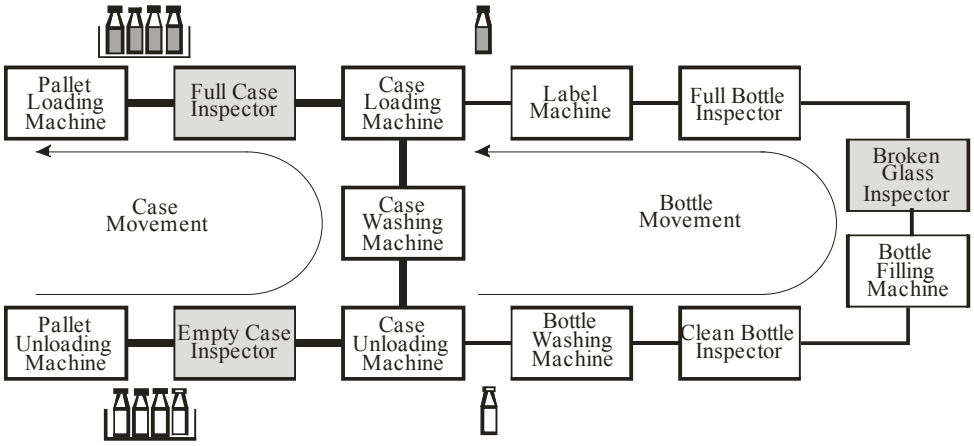

Fig. 1. Structural scheme of a bottle conveyer.

The bottle conveyer comprises of several machines working together. At the input of the system come pallets fully loaded with cases, which contain bottles. The first two machines unload the pallets and empty the cases. Then the cases are separated from the bottles, which pass through several machines, where they are washed, cleaned, dried, filled, closed and labeled. Then again the bottles are loaded into cases

and the cases – loaded into pallets. At several crucial places among the beverage machines are situated electronic devices collecting technological data from the running line. These devices are called inspectors and are actually PLC (Programmable Logic Controller) devices. They collect data such as: number of cases entered the line, number of empty cases, number of bottles entered, number of broken bottles, number of bottles removed from the line, number of full loaded cases, etc [4, 9]. This technological data allows watching the industrial process, performing an early diagnostics and estimating the work of the running aggregates. This also enables estimating of numerous technological parameters, such as: total productivity, reasons for and moments of idle time and so on. For the current realization of the beverage line, technological data is taken only from the inspectors shown in gray (fig. 1).

2. Structure of the Information System for Beverage Lines

Peculiarity of the developed information system is the fact, that it is adopted in a complete and fully functional bottle conveyer [1]. The machines and the units of this conveyer are operated by local controllers. The main issues that should be cleared up when developing an information system are:

– Deciding what sort of information should be gathered;
– Deciding which machines this information should be gathered from;
– Providing the machines with the necessary network functions;
– Organizing the information system itself.

The first two of these issues are solved by an expert estimate of beverage specialists. Topic of the current paper is the last issue.

The information system proposed comprises two subsystems (as shown on fig. 2).

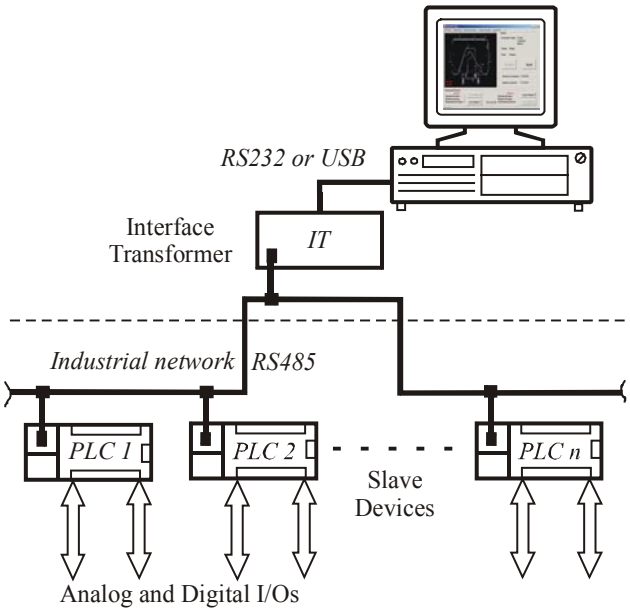

Fig. 2. Structure of the information system for bottle conveyers.

The first subsystem combines the functions for collecting and processing data and is built upon a Personal Computer (PC) supplied with suitable Interface Transformer (IT). The second subsystem includes the controllers from the selected machines (the inspectors collecting technological data) [3]. It has an open architecture, which means that Programmable Logic Controllers (PLC), intelligent sensors and executive mechanisms can be included at any time. [5, 6]

The information system serves two identical independent cooperative bottle conveyers. The controllers from both of the conveyers are connected in a common industrial area network. Along with real time control of the production processes, each of the controllers collects technological data.

3. METHOD FOR COLLECTING AND PROCESSING DATA

The controllers from the conveyer are concentrated in three basic points: in the beginning of the conveyer – Empty Case Inspector, in the middle – Broken Glass Inspector and in the end – Full Case Inspector (fig. 1). These controllers provide the technological data for the industrial process and are shown on the scheme as grey rectangles.

The technological data that Empty Case Inspector collects includes: the number of pallets, the number of cases and the number of empty bottles. Broken Glass Inspector collects data for the bottles entered into the Bottle Filling Machine, the bottles left the Bottle Filling Machine, the broken bottles and the full bottles that have left. The technological data that Full Case Inspector collects includes: the number of full bottles, cases and pallets, and also the cases being suited.

The method for collecting technological data consists of cyclic inquiry the controllers in the network. The controllers are enquired for their state and for the collected statistic information (mentioned above) [2]. As a routine method for collecting data by using a PC is chosen the approach on organizing a database.

The database comprises of several tables storing statistic data for the running process and also service data for the work of the information system itself. This service data consists of information about the available microcontrollers currently connected to the industrial area network (name, serial number, state and a brief description of its functionality).

In two different tables is formed a register of the working staff organized in teams, shifts, head of shifts and so on. The first one contains the registered teams working with the beverage line, while the second one contains a list of people, authorized to work with the information system (usually head of shift and administrators). This information is complemented with information for the team whose member is the corresponding worker and his privileges.

As the information system maintains confidential information that is essential to be kept in safe, different levels of administrative privileges are embedded in it. The registered workers occupy different administrative levels, which give them different rights to access the stored information. For supporting these features, the information

system is provided with a simple authentication system. For working with the program, the user should provide a username and a correct password. This confidential data for each registered user is kept in the database in encrypted form and each time an user logs on, it is checked for coincidence.

4. APPLICATION PROGRAM OF THE MAIN STATION

In order the Personal Computer (PC) to assume the functions of collecting and processing technological data from the running conveyer, special software is developed. It is a stand-alone Windows application, provided with a Microsoft Access-type database (*.mdb) for data storing. The technological data collected is stored in the database, sometimes for a long time, and on its basis can be prepared appropriate report documents for production shift, day, month, year etc. Both the application and the database file are situated on one and the same machine – the main station.

The program created aims to give potentials for control and monitor of production processes and also to facilitate giving of reports. It is intended for use by the production staff and particularly by the foreman of the shift. Almost all of its functionality is available from the main window which is shown on fig. 3. The diagram occupying much of the front panel represents schematically the structure of the industrial production line (the situation of all of the machines maintaining the bottles in the beverage line).

Main features of the developed program are:

– Database support for information of the working teams, shifts, foreman of the shift and the firm (organized in several tables in the database, containing crucial information for the correct work of the system);

– Information support for the structure and the state of the controllers and the conveyers (thus the system notes all changes in the organization of all the machinery);

– Authentication system support, for restricting the access to the resources for control and monitoring by incompetent users (password authentication and data encryption);

– Communication with the controllers from the network via RS232 (using serial port of the PC);

– Setting the parameters for serial port communication (baud rate, parity check and so on);

– Communication with the controllers from the network via USB;

– Driving the controllers in two modes (standard mode and test mode with possibilities for command sending, data enquiry and sending, parameters enquiry and sending and states enquiry and sending);

– Managing the controllers virtually organized in two conveyers (the system is designed to serve and work with two independent simultaneously running production lines);

– Report of the production load of each of the lines (this option is visualized

graphically);

– Report of the production levels reached, organized by date, team and shift;

– Real time visualization of the production's state (allows tracking the production processes and take preventive actions if necessary, in case something goes wrong with the machinery);

– Intuitive and easy to use user interface.

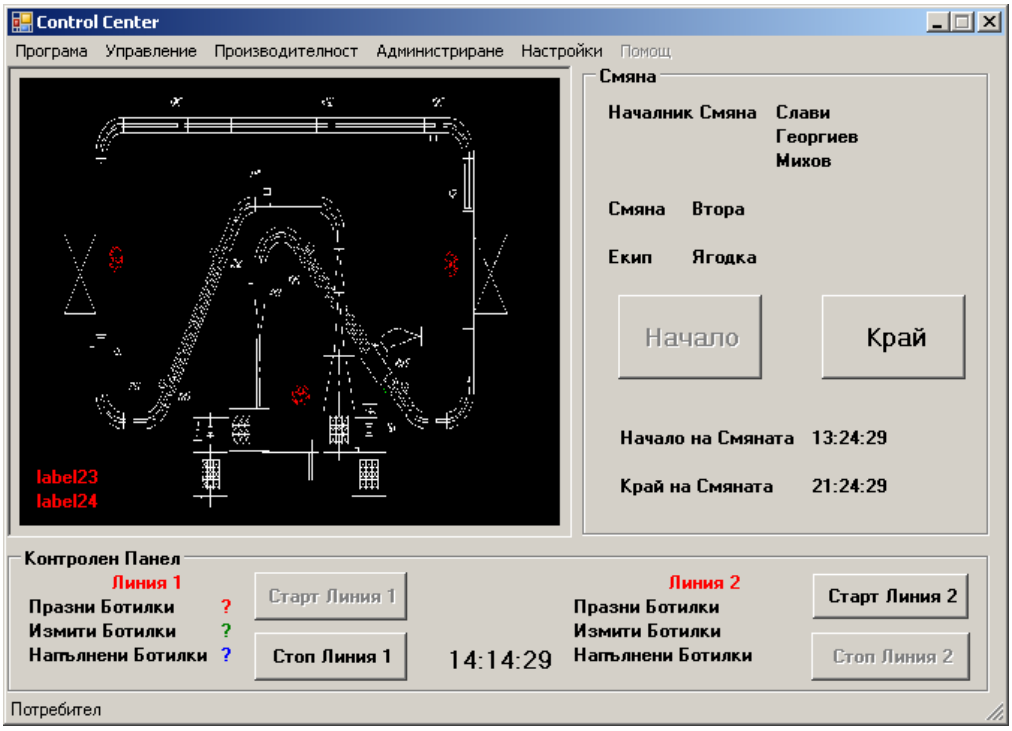

Fig. 3. Main window of the application.

The software part of the information system is developed through the Integrated Development Environment (IDE) **Microsoft Visual Studio 2005** which supports .NET technology for software development [7]. As a result of the source code compilation, a managed code executable module is created. This is not a binary executable, but a list of Microsoft Intermediate Language (MSIL) instructions. For executing this file is needed the host platform to support a MSIL interpreter. The core of .NET technology is MS .NET Framework platform which provides all the necessary tools for running managed code modules.

The system requirements can be generalized in:

– **Operation system** – Microsoft Windows 98, Microsoft Windows XP, Microsoft Windows 2003;

– **Platform** – Microsoft .NET Framework 2.0;

– **RAM** – according to the requirements for stable running of the operation system (128 MB and more);

– **HDD free space** – 3 MB for the application (not included the *.mdb database

file).

It makes an impression that the HDD free space requirements are very low. This is so, because much of the functionality of the program is encapsulated in MS Windows and MS .NET Framework Dynamic Link Libraries (DLLs) and ActiveX Control modules. Besides, the HDD free space requirements are very conditional because along time by using the developed information system, the database file keeps on growing and it can reach enormous sizes.

The program of Control Center can be run on every operation system which can support MS .NET Framework. These are MS Windows 98 and newer. It is known that MS Windows XP and 2003 come along with an integrated .NET Framework platform, but for running this application is essential a newer version (such as MS .NET Framework 2.0) to be installed.

5. CONCLUSIONS

The development in the present paper "steps" upon existing system of industrial controllers. It upgrades one existing, functional and adopted in production system for control and monitoring of production processes. It is oriented for the needs of bottle conveyers. The developed information system uses a method for cyclic enquiry and stores the data in a database, which allows further processing of the collected data to be done via another application (according to the specific needs). The application program is flexible and can be used in various tasks and by this means to facilitate greatly management, control and reports in industrial production processes.

The program itself is developed according to a new and vanguard technology, as Microsoft .NET technology is. It possesses all of its benefits among which are: facilitated development, safe and stable usage and also system portability.

6. REFERENCES

[1] Dimitrov, E., G. Mihov, S. Jilov. *Microprocessor - Based Inspection Equipment for Partially Supplied Cases*. The 32-nd International Scientific Symposium of the Defense Research Agency, vol. IV, pp. 105-110, Bucharest, Romania, April 2001.

[2] Tashev, I. *Methods, devices and systems for collecting and processing data.* Book for distance learning, TU – Sofia, 1997 (in Bulgarian).

[3] Dimitrov, I. *Organization and diagnostics of microprocessor systems for industrial control*. Ph.D. thesis, TU – Sofia, 2001 (in Bulgarian).

[4] Dimitrov, E., G. Mihov, M. Mitev. *Local area network for industrial controller*. EIST-2001, p-p 608-613, Bitola, Macedonia, 2001.

[5] Mihov. G., E. Dimitrov, S. Jilov, A. Kostadinov. *Composing of Different Local Area Networks for Industrial Controllers on Common Physical Layer*. XXXVII International Scientific Conference on Information, Communication and Energy Systems and Technologies ICEST '2002. vol. 2 pp. 406-409, Niš, Yugoslavia, October 1- 4, 2002.

[6] *Modbus over serial line specification and implementation guide* http://www.modbus.org

[7] Goranova, M. *"C# Programming"* Lection Course, 2005.

[8] Ovcharov, S., P. Jakimov. *Instrumental Interface for industrial network building.* Journal "E+E", No 3-4, pp 10-14, 2005 (in Bulgarian).