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DEVELOPMENT OF AN INFORMATION CONTROL SYSTEM FOR AUTOMATIZATION OF THE ACTIVITIES OF RETAIL TRADE ENTERPRISES

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Information control systems are widely used to automate the activities of retail enterprises. This is a mandatory component of successful business processes in trade organizations, which also contributes to improving the quality of services for customers. Currently, information control systems are widely used for retailers in e-commerce. This makes it possible to ensure: timely delivery of goods to enterprises and consumers; eliminate intermediaries; improve storage conditions for goods; shorten supply chains; ensure 24-hour staffs work. All this contributes to improving the efficiency of retail enterprises. However, often the implementation of information control systems for such purposes is a financially costly and time-consuming process. The introduction of such systems leads to a significant reduction in employees of trade organizations. In addition, the purchase of products and everyday goods is less realized online, and therefore the coordinated work of cash registers at retail enterprises remains an urgent task. In order to preserve the traditional processes of functioning of retail enterprises with the preservation of the number of employees, the article proposes to increase the efficiency of their work by introducing special interfaces for managing the coordinated work of cash registers with informing employees and customers. The purpose of the article is to develop an information control system for automating the activities of retail enterprises, ensuring the smooth operation of cash registers. To achieve this goal, the following tasks related to the development were solved: the structure of an information control system for automating the activities of retail enterprises; software; hardware implementation of an information control system that ensures the smooth operation of cash registers.

Keywords: information control system, software, management interfaces, automation, retail, cash registers, customer satisfaction, efficiency

Introduction

The increasing competition between manufacturers, free pricing, coupled with the growing level of self-regulation of retail enterprises, force each individual enterprise to focus its efforts, first of all, on achieving economic goals - improving work efficiency, maximizing profits and reducing costs [1-4]. One of the most important components in this process is the management of information flows associated with the functioning of such enterprises. Information control systems (ICS) are widely used to automate the activities of retail enterprises. This is a mandatory component of successful business processes in trade organizations, which also contributes to improving the quality of services for customers [5-9].

According to the research "TECHNOLOGY AT WORK v3.0. Automating e-Commerce from Click to Pick to Door" [10] from Citi GPS: Global Perspectives & Solutions, the ICS of automatic cash registers, as well as robot assistants that ensure the smooth operation of cash registers, is a promising and cost-effective direction for retailers. This approach helps to increase the demand for goods, save on the maintenance of employees, improve the quality of goods and trust in them from customers. However, according to Morning Future [11], the introduction of automatic maintenance and robot assistants still remains a financially costly and time-consuming process and is accompanied by a significant reduction in employees of trade organizations. An example of a different use of ICS for retailers is the analysis of the

BNN Bloomberg food consumption report [12], indicating the successful use of e-commerce (online shopping). This also confirms the use of the OWR wise robotics service platform [13] in ICS for contactless commerce, which allows for: timely delivery of goods to enterprises and consumers; eliminate intermediaries; improve storage conditions for goods; shorten supply chains; ensure 24-hour staffs work. However, the purchase of products and everyday goods is less realized online, and therefore the coordinated work of cash registers at retail enterprises remains an urgent task.

The purpose of the article is to develop an ICS for automating the activities of retail enterprises, which ensures the smooth operation of cash registers.

To achieve this goal, it is necessary to solve the following tasks related to the development: the structure of the ICS for automating the activities of retail enterprises; software; hardware implementation of the ICS, which ensures the smooth operation of cash registers.

Information control system for automating the activities of retail enterprises

The basis of the developed ICS for automating the activities of retail enterprises is based on the created SRS (smart retail system) system with the developed software that ensures the smooth operation of cash registers (Fig. 1). The lower level of the system is designed for processing statuses and calls from the cash desks.

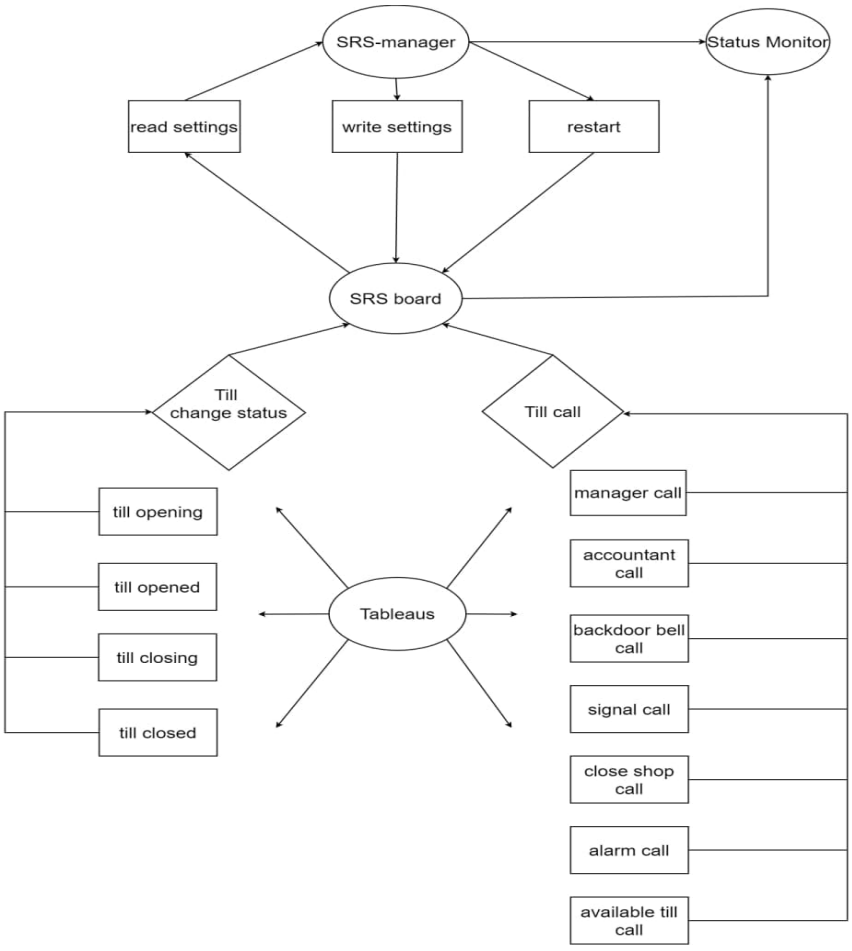

Fig. 1. Diagram of the SRS system functioning

The ICS operates in a continuous event processing mode. For example, if a request to open a cash register comes from the tabby (remote controls), the system generates audio that notifies the staff about the opening of the cash register, which is also accompanied by a glow on the scoreboard, the corresponding LED in green. During the operation of the system, it is

also provided to unlock such functions as: calling the manager; replacing cashiers; notification of the imminent closure of a trade organization; notification of employees leaving for a break; turning on an alarm, etc. The system also processes information from expansion boards, namely about a long queue of buyers from motion sensors, signals from the security service, signals from virtual cash registers and others. The ICS has embedded microprocessors, the program code for which is written in the C programming language in the IAR Embedded Workbench IDE development environment [14]. Each functional department is located in a separate file or folder (Fig. 2).

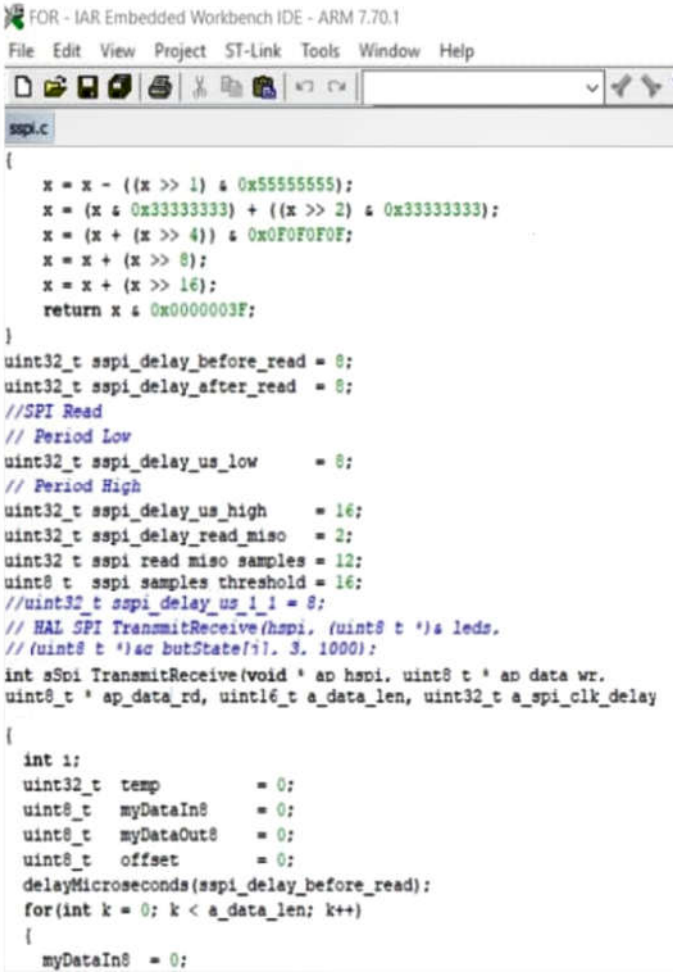

Fig. 2. Program code window

The main configuration files are located in the JSON folder. ICS users have the opportunity to customize the behavior of the system to their needs using the SRS-manager program. The program is written in the C# programming language in the Visual Studio development environment [15] and is designed to work on Windows OS. In the program, you can set the settings for each SRS function. The program is a window with control buttons for templates, firmware, information about the connected ICS board and tabs for specifying settings for the system. For example, the SRS manager window - General Settings (Fig. 3) - configures the main settings, such as: opening settings, closing settings, checkout settings (tills), Express mode settings.

Hardware implementation of an information management system for automating the activities of retail enterprises

Hardware SRS system is the main board SRS board. The structure of the hardware of the board corresponds to the graph model (Fig. 4) [16].

The SRS board (Fig. 5) records, processes status changes and generates cash register calls. This data is displayed in the Status monitor, as well as in various colors of LEDs on the remote control, playing audio files, etc.

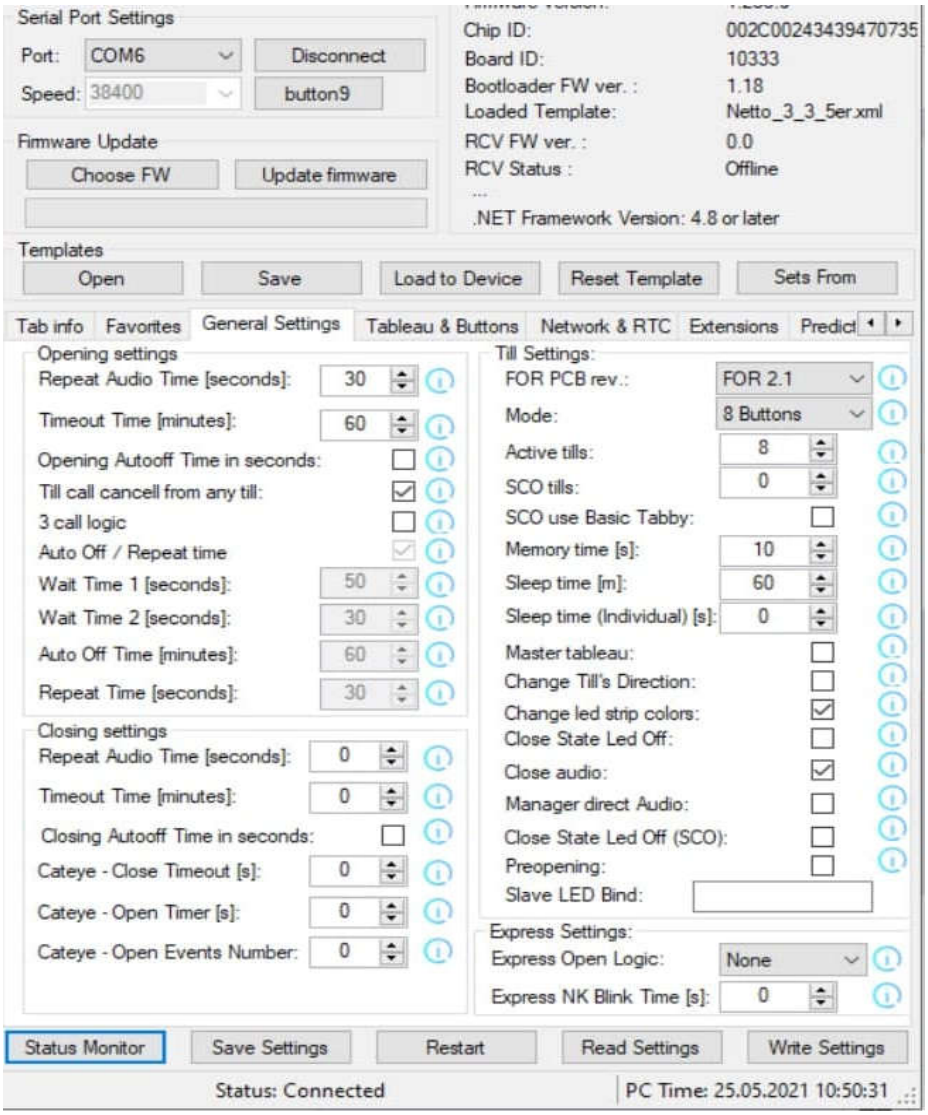

Fig. 3. SRS Manager window. General Settings

There are ports on it: 8 till ports for cash desks (tabby) - they are used by employees of cash registers; CAN port for connecting additional boards, such as an expansion board, for example, for 16 cash registers; a board for working with queue sensors, a board for working with staff walkie-talkies, etc.; RS 232 port for debugging functions; Ethernet port for connecting the board to an Ethernet network; two audio ports for outputting audio files; USB port for connecting to a computer (or to a Raspberry Pi board); port for SD-card - audio files are stored on it and some program procedures take place; eight ports for LED strips (LEDs) reflecting the status of cash registers for buyers; two I/O ports (input/output) for connecting a call at the back entrance (Backdoor Bell) or U I expansion boards / O; two OUTPUT ports for the output of additional signals; a port for the power supply of the board 24V DC. In addition to the AMD microprocessor, non-volatile memory, jumpers and other circuit elements are

placed on the board. A firmware bit file is programmatically sewn into the microprocessor, providing functions: storing user values; performing calculations and calculations; processing and generating events; communicating with additional devices, etc. The microprocessor is supplied with power through the lm2576hvs-adj stabilizer and deep switches. Deep switches are designed to reconfigure the operating modes of the board at a low (deep) software level. Non-volatile memory allows you to save the internal countdown of the operation of the board even in the off state, as well as save the system statuses for a while in case of power failures of the board.

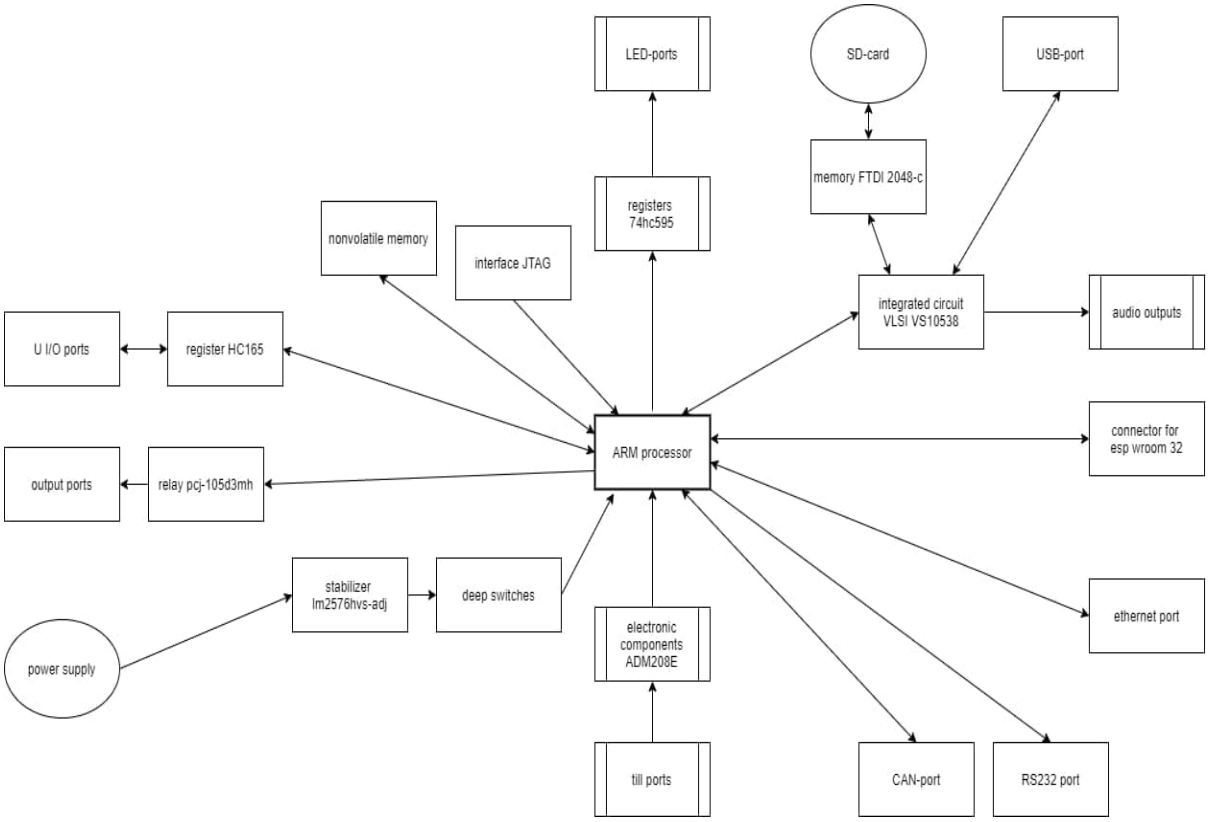

Fig. 4. SRS-board hardware model

The board settings are configured using the SRS-manager program. The SRS board is usually placed in the server room.

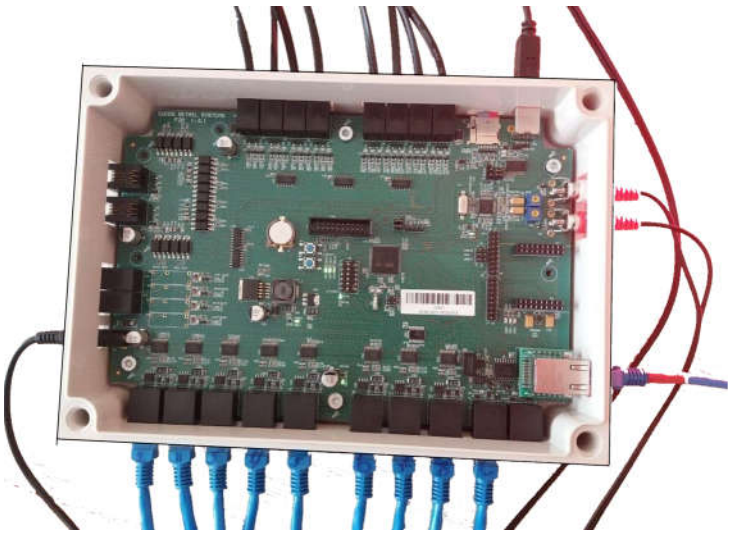

Fig. 5. Photo of the SRS board

The JTAG interface is used when updating the processor firmware with the STM32 ST-LINK programmer [17]. From the upper side of the board model (Fig. 4), LED strips are connected to the LED ports, signaling customers and staff about the status of cash registers and queues. The ports are connected to the microprocessor via registers 74hc595. The SD card stores the audio files of the system, the current settings file, and also performs some processes (for example, online downloading of settings from the server). The SD card works in conjunction with FTDI 2048-c memory. Thus, a trade organization with the help of additional software can configure the settings and behavior of the system, monitor the status of the ICS through a remote computer device.

Audio from the events that have occurred is output to two audio ports. Audio files are distributed into two channels, due to which one part of the audio can be played for customers, and another part for staff. The SD card, USB port and audio ports are connected to the VLSI VS10538 chip, which preprocesses signals before they are fed to the microprocessor. Connectors for esp wroom 32 are a potential API functionality for connecting ESP boards. Using an Ethernet cable, the board can be connected to the Internet or a local network. T ill ports are used to connect control panels at the cash desks. These ports are connected to the microprocessor via ADM208E preprocessor electronic components.

The results of the functioning of the information management system for the automation of the activities of retail enterprises

The functioning of the developed ICS for automating the activities of retail enterprises is illustrated in the Status Monitor. It displays class statuses, expansion board statuses, network statuses and online updates, and also performs testing of various software functions.

Figure 6 shows the operation of the built-in consoles in an experimental store in Dusseldorf (Germany). Figure 7 shows that the third, fifth, sixth, eighth and ninth cash registers are operating at a fixed moment. The store employee presses the OK button to close the third checkout. To the left are the buttons for calling a store employee (Markt Accountant) and a manager (Markt Leitunger).

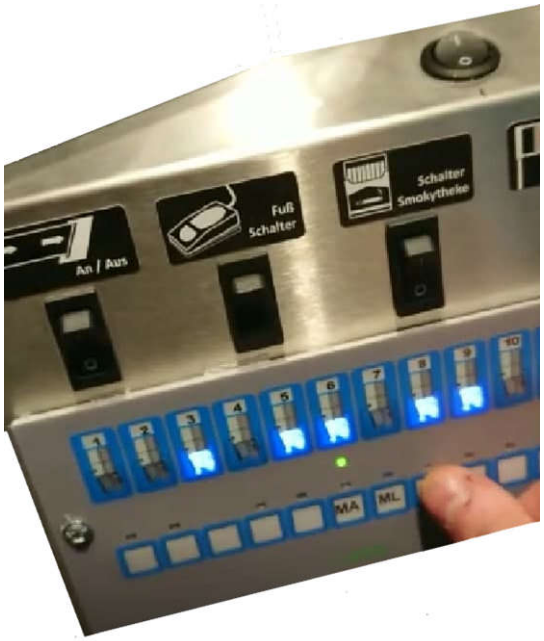

Fig. 6. Using the built-in remotes

Figure 7 shows the following areas of the Monitor Status:

- Tableaux Status - statuses of the main cash registers;
- Slave Tableaux Status - additional cash register statuses;
- Monitor - Setting the data refresh rate Monitor status;
- Expansion IO Status - status of signals on UIO ports;
- Occupation Status - applicable Occupation settings;
- Network Status - Internet connection, online status - settings and firmware updates, IP address and DNS settings;
- Audio Library Update Status - status of online audio file updates;
- Hardware Tests - forced launch of the U-IO ports test, LED strips, online updates.

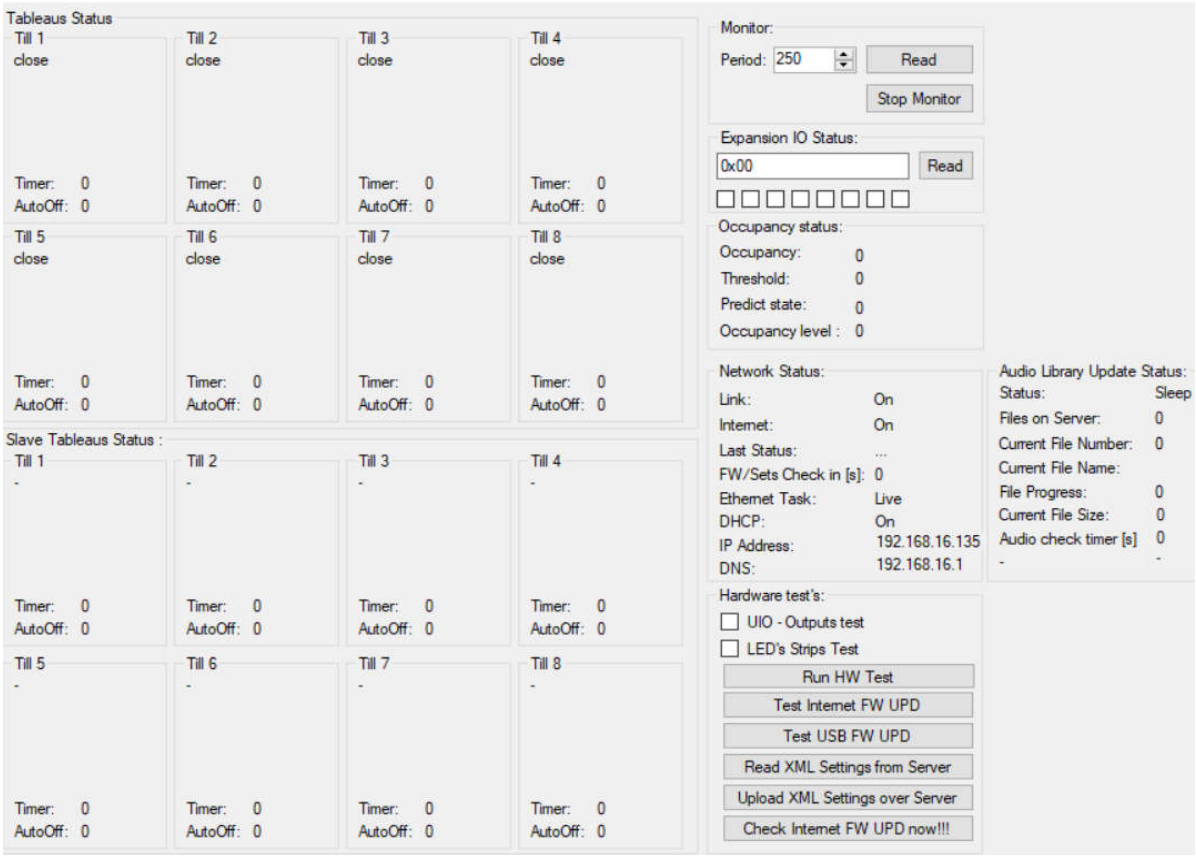

Fig. 7. Status Monitor

Conclusions

In order to increase the efficiency of work and automate the activities of the personnel of retail enterprises, an ICS has been developed that ensures the coordinated operation of cash registers.

To achieve this goal, we have developed: the structure of the information and control system for automating the activities of retail enterprises; software; hardware implementation of ICS, ensuring the smooth operation of cash registers.

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РОЗРОБКА ІНФОРМАЦІЙНО-КЕРУЮЧОЇ СИСТЕМИ ДЛЯ АВТОМАТИЗАЦІЇ ДІЯЛЬНОСТІ ПІДПРИЄМСТВ РОЗДРІБНОЇ ТОРГІВЛІ

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Інформаційно-керуючі системи широко використовуються для автоматизації діяльності підприємств роздрібної торгівлі. Це обов'язкова складова успішних бізнес-процесів в торгових організаціях, що сприяє також і підвищенню якості послуг для клієнтів. В даний час широко використовуються інформаційно-керуючі системи для підприємств роздрібної торгівлі в е-комерції. Це дозволяє забезпечити: своєчасну доставку товарів на підприємства і споживачам; усунути посередників; поліпшити умови зберігання товарів; скоротити ланцюжки поставок; забезпечити 24-годинну роботу персоналу. Все це сприяє підвищенню ефективності роботи підприємств роздрібної торгівлі. Однак часто реалізація інформаційно-керуючих систем подібного призначення фінансово витратний і трудомісткий процес. Впровадження подібних систем призводить до істотного скорочення працівників торгових організацій. Крім того, покупка продуктів і повсякденних товарів в меншій мірі реалізується в онлайн, а тому злагоджена робота кас на підприємствах роздрібної торгівлі залишається актуальним завданням. У статті пропонується для збереження традиційних процесів функціонування підприємств роздрібної торгівлі зі збереженням кількості працівників підвищити ефективність їх роботи за допомогою введення спеціальних інтерфейсів управління злагодженою роботою кас з інформуванням співробітників, а також клієнтів. Мета статті-розробка інформаційно-керуючої системи для автоматизації діяльності підприємств роздрібної торгівлі, що забезпечує злагоджену роботу кас. Для досягнення поставленої мети були вирішені наступні завдання, пов'язані з розробками: структури інформаційно-керуючої системи для автоматизації діяльності підприємств роздрібної торгівлі; програмного забезпечення; апаратної реалізації інформаційно-керуючої системи, що забезпечує злагоджену роботу кас.

Ключові слова: інформаційно керуюча система, програмне забезпечення, інтерфейси управління, автоматизація, роздрібна торгівля, каси, задоволеність клієнтів, ефективність.