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IMPLEMENTACIJA SUSTAVA I APLIKACIJA SOFTVERA ZA MONITORING SUSTAVA SIGURNOSTI HRANE U DJELATNOSTI UGOSTITELJSTVA

IMPLEMENTATION OF THE SYSTEM AND APPLICATION SOFTWARE FOR THE MONITORING OF THE FOOD SAFETY SYSTEM IN HOSPITALITY

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Stručni članak

Sažetak: *U cilju osiguravanja sustavnog i kontinuiranog nadzora KT i KKT HACCP sustava u djelatnosti ugostiteljstva, čime se osigurava sigurnost hrane, moguće je primijeniti informatičku podršku. U slučaju kada se radi o velikom broju uređaja (rashladne i termičke opreme) s velikom dislokacijom unutar cijelog objekta, odgovarajuće rješenje nudi se kroz uspostavu sistemske i aplikativne programske opreme centralnog nadzornog sustava (CNS). Sastoji se od sistemske i aplikativne programske opreme. Sistemska oprema postavljena je putem „novaPro“ stanica sa oznakom MASTER i Function Block Diagram programom. Aplikativnu opremu čine nadzorni sustav, alarmiranje na nadzornom nivou (NN), izvještaji, sustav AS-a (automatske stanice), kronologija na NN i zaštita na NN. Sastav programske opreme nastao je na temelju zahtjeva korisnika. Jedan takav sustav nadzora prikazati će se i u ovome radu. Prednosti sustava iskazuju se u kontinuiranom monitoringu, trenutnom prepoznavanju odstupanja od postavljenih parametara, ustanovljavanju kvarova opreme, olakšanom dokumentiranju parametara i stvaranju baze podataka koji se mogu iskoristiti za analizu trendova i provođenje preventivnih radnji, što utječe i na optimizaciju ljudskih resursa.*

Ključne riječi: *informatizacija, HACCP, rashladna oprema*

Professional paper

Abstract: *In order to ensure a systematic and continuous monitoring of CPs and CCPs of the HACCP system in the hospitality sector – which ensures food safety – it is possible to provide support using information technology. In the case of a large number of devices (refrigeration and cooking equipment) spread across the entire facility, the proper solution is offered through the implementation of the system and application software equipment of the central monitoring system (CMS). The system equipment is realized via "novaPro" stations marked MASTER and Function Block Diagram programme. Application equipment consists of a control system, alerting on the monitoring level (ML), reports, AS (automatic stations) system, the ML chronology and the ML protection. Specification of software was created based on user requirements. Such a monitoring system will be presented in this paper.*
The advantages of the system are reflected in the continuous monitoring, in momentary identification of deviations from the current set of parameters, in establishing equipment failures, in facilitated documenting of parameters, and in the creation of a database that can be used for trend analysis and implementation of preventive actions, which affects the optimization of human resources.

Key words: *informatization, HACCP, refrigeration equipment*

1. INTRODUCTION

The new concept of food safety insurance stems from the fact that safety depends on the control of all procedures, including the system of hospitality (Uršulin-Trstenjak, Vahčić, Šušnić, 2008). The importance of the concept is in its preventive activity focused on the control of procedures, not the status of the final product (Uršulin-Trstenjak, Šušnić, 2005). The legal framework for the introduction of the HACCP system is defined by the Food Act and the Food Hygiene Regulations (NN xx/2013; NN 118/2009). It is based on seven principles based on hazard and risk analysis (CAC/RCP 1-1969, Rev 4-2003).

In order to ensure a systematic and continuous monitoring of each Critical Point (CP) and Critical Control Point (CCP) – required by the Principles 3 and 4 of the HACCP system in the hospitality – it is possible to provide support using information technology (Sun, Ockerman, 2005; Šušnić, Šušnić, 2004; Uršulin-Trstenjak, 2004). Such a monitoring system implemented in the hospitality of the hotel Termal in Daruvarske toplice (spa and wellness facility in Daruvar) will be presented in this paper. CPs and CCPs are defined by the creation of the HACCP plan. Some of them are monitored by the central monitoring system (CMS): CCP4-food serving (cold), CP3-storage (freezing) and CP2-storage (cold).

2. AIM OF THE PAPER

The aim of this paper is to give an overview of ensuring the systematic and continuous monitoring of CPs and CCPs of the HACCP system in hospitality – the hotel Termal in Daruvarske toplice – using the information technology support regarding the refrigeration equipment: storage (freezing), storage (cold) and food serving (cold).

3. MATERIALS AND METHODS

3.1. Applying the Principles 3 and 4 of the HACCP system

By implementing the HACCP system in hospitality of the hotel Termal in Daruvarske toplice the HACCP team and its members' duties have been defined; the description of the product has been made; the flow chart has been developed; hazards have been identified and risks have been estimated; CTs, CCPs and critical limits have been determined; corrective actions have been defined together with the method of documenting the system verification.

- By applying the Principle 3 of the HACCP system the critical limits have been established – they are specified, validated and measurable for each CP or CCP related to measuring the temperature;
- By applying the Principle 4 of the HACCP system the procedure of monitoring the CPs and CCPs has been defined (CAC/RCP 1-1969, Rev. 4-2003).

All documents and records related to the monitoring of CPs and CCPs are signed by the person conducting the monitoring and are approved by the person responsible.

3.2. Specification and description of the central monitoring system for measuring the temperature in the refrigerators of the hotel Termal, Daruvarske toplice

Central monitoring system (CMS) is formed so as to ensure the central control and management of the temperature measurement systems in refrigerating chambers, refrigerators and kitchen areas of the hotel Termal, Daruvar. Automatic stations (AS) of local monitoring and control function on the principle of direct digital control (DDC) according to the programs made in a special programming language developed for the purpose of automatic control and monitoring of these thermo-technical and other installations. Each AS substation performs automatic regulation and storage of the data collected independently of the communication with the central computer. Operations control, collected data review and control can be conducted by using the local control unit connected to the AS substations.

CMS consists of a standard computer configuration which contains elements available on a wide market. The interface for connection to the AS substations is connected to the standard communication port of the computer. "novaNET" system bus, which enables communication based on the question-answer principle, is used for communication between the computer and AS substations, with all the changes registered by the AS substations and then being sent through novaNET connection to the control station where the data are further processed, displayed on the screen, stored in memory and/or printed out. Termination of operation of one of the AS substations does not interrupt communication between the computer and the other substations, or between AS substations. Monitoring part (Figure 1) of the whole system is performed on the "novaPro" station marked MASTER.

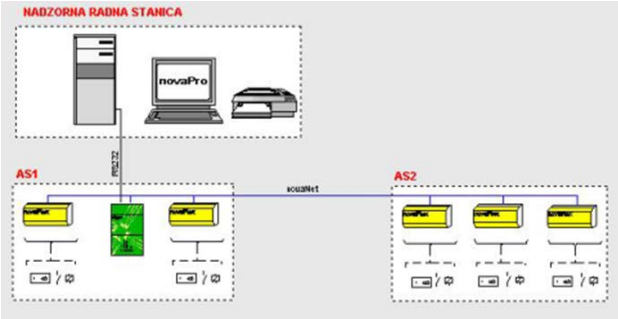

Figure 1. Monitoring station

Given the fact that there is a large number of devices (refrigeration and thermic equipment) that CPs and CCPs are connected to which are spread across the facility, the optimal solution for monitoring the temperature is offered by implementing the systematic and application software of the CMS.

Specification of software was created based on user requirements and architectural design documents.

The computer with "novaPro" station installed contains the following software: Operating system (Windows 2000), "novaPro" system (SWMLIGHTUSB – USB-Dongle, Licence 150 DP, 1 PC), control program for communication with the controller within the "novaPro" package (EY3600 drive) and Tool for report preparation (SWMPBPROT). The applications on automatic stations (AS) have been created using a program specified by the producer CASE FBD editor v 5.0 SR2.

3.3. Alerting on the monitoring level (ML)

If the value of the input signal differs from the set value, the alarm is activated. Certain alarms that are defined after its creation cause a predefined action or are of warning character. The monitoring level takes over the information on the occurring alarms and displays them to the user in different ways.

The ways of grouping and displaying different alarms will be described in this part of the paper. The display of a specific alarm is described within the description of the system functionality.

The alarm information on the monitoring level is divided into groups (Table 1).

Table 1. Groups of alarm information

Group	Group description	Action
AL	Alarm	The alarm activates a specific action on the AS level – turning on the signal bulb or siren. The information on the alarm is forwarded to the ML. Quitting is performed by using the ML button…in case there is the function of retaining the alarm condition, after the cause was removed.
LV	Limit values	The alarm activates a specific action on the AS level – affecting the regulatory function. The information on the alarm is forwarded to the ML.

For each alarm group the following is defined: the request for acceptance by the operator as well as the request for the image change (system display in which the alarm occurred), the text colour of the information on the alarm at its occurrence, acceptance and disappearance, the printing of the occurrence, acceptance and disappearance of the alarm, and sending the alarm information to a printer or software clip.

A short text description of the last alarm information received is displayed in the yellow field located in the bottom left corner of the screen (Figure 2). The screen automatically displays the image of the system that sent the alarm information. The presented regulatory element or device that sent the alarm information is filled with the warning red. The arrival of a new alarm is accompanied by a short beep on the computer. The printer prints out the addresses of the alarm point, the short text information on the type of the alarm and the time of its occurrence, acceptance or disappearance. The information on the alarm is automatically entered in the Alarm Journal.

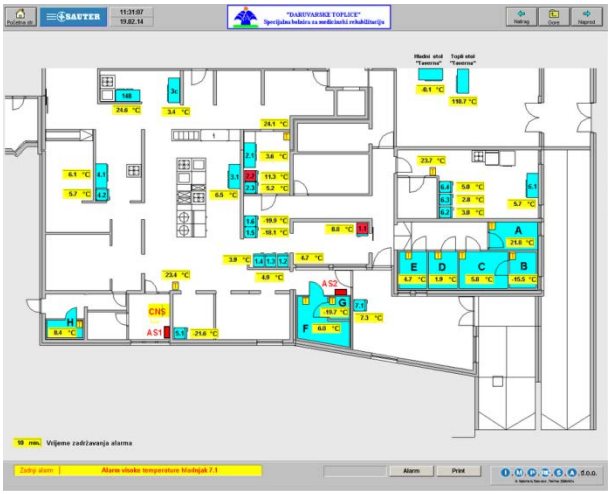

Figure 2. An overview of refrigeration equipment

3.3.1. Reports on the alarm activities on the monitoring level (Alarm Journal)

By clicking on the ALARM button a window novaPro - Alarm Journal is opened.

In the Alarm Journal, all the current, accepted and interrupted unaccepted alarms are listed in different colours: RED (current alarm), PURPLE (accepted current alarm), GREEN (unaccepted interrupted alarm), GREY (alarm not required to be accepted, accepted interrupted alarms).

The confirmation of the alarm on the on-screen Alarm Journal using the button "Acknowledge" has nothing to do with the function of quitting (reactivating the system or functions after removing the cause of the alarm). By acknowledging the alarm the operator only confirms that he is familiar with the events in the process.

3.4. Monitoring level protections

The monitoring level is protected from an unauthorised system handling with the log-in system. The application software (novaPro) has the option of downloading a valid Windows protection system or it can create it by itself. Each user has their own user name and password. The users are divided into groups according to the permission assigned to each group (Table 1).

Table 2. User groups

Group name	Label	Description of the permission in the system
Start Guest	G	General group without special permission, it only allows an overview of screen images, without active system control (the access to the chronology and an overview of the alarm is not enabled). The exit from ML to the operating system is not allowed. To switch from the Main image to other images of the system the window for user registration automatically opens.
Technologist	T	It has all the permissions of the group Start Guest + allowed changing of the set values, setting the limit alarm values, disconnection of the control system, etc.
System administrator	S	It has all the permissions of the group Technologist + enabled exit to the ML to the operating system, the access to system files and the change of the ML application.

3.5. Instructions for working with the computer

Employees responsible for monitoring the CPs and CCPs and registry lists management work according to the defined instructions.

3.5.1. Basic instructions for working with the computer

The computer is designed for monitoring the temperature of the refrigeration devices in the HACCP system, and the use of computers for other purposes is prohibited. The computer must be turned on at all times.

No external devices are to be inserted into the computer, nor the attached devices are to be removed from the computer. It is not allowed to insert any data transfer media into the computer (CD, DVD, floppy discs, memory stick, etc.).

In case the screen becomes dark, moving the mouse or pressing any key will again enable the image display. When you see the image on the screen, follow the on-screen instructions.

3.5.2. Basic instructions for working with the programme

The main screen of the program is 'TEMPERATURE MEASUREMENT'. There you can see the temperature of different measurement locations. In the case of the temperature that exceeds the given parameters, the measurement location changes colour to red (ALARM CONDITION).

In case the alarm is activated, it needs to be checked whether the device is switched on, whether the device is in the condition of defrosting (DEFROST), whether the door is closed, whether a greater amount of fresh goods has been inserted.

If the alarm is not caused by any of the above, be sure to call the technical service engineer on duty and fill in the Records on identifying inconsistencies.

4. RESULTS

4.1. Risk analysis

As the result of the HACCP system implementation in the hospitality of the hotel Termal in Daruvarske toplice, 6 CPs and 5 CCPs have been defined by analysing the risk of each phase of the process. In this paper, CP2-storage (cold), CP3-storage (freezing), and CCP4-food serving (cold), have been discussed.

4.2. Monitoring of CPs and CCPs

Those CPs and CCPs that monitoring is related to by the surveillance of the critical limits of the temperature measurement by using the information technology equipment are as follows: CP2-storage (cold), CP3-storage (freezing), and CCP4- food serving (cold) (Table 3).

Table 3. HACCP plan – CCPs and CPs

PROCEDURE	CP/CC			CRITICAL LIMITS (CL)		MONITORING		
	#	DESCRIPTION	DANGER	#	DESCRIP-TION	PROCEDURE	FREQUENCY	PERSON RESPONSIBLE
CP 2 Storage COLD	2	Storage temperature control	**Microbiological:** Microbial growth due to inadequate storage conditions. **Chemical:** Production of toxins of microorganisms present in raw materials.	2.1.	Storage temperature: according to the settings of the CMS (temperature requirements on the label)	Temperature monitoring through the CMS (temperature deviation shown in red)	Continuously every 2 minutes	Chef
CP 3 Storage FREEZING	2	Storage temperature control	**Microbiological:** Microbial growth due to inadequate storage temperature. **Chemical:** Production of toxins of microorganisms present in raw materials.	2.2.	Storage temperature: according to the settings of the CMS (temperature requirements on the label)	Temperature monitoring through the CMS (temperature deviation shown in red)	Continuously every 2 minutes	Chef
CCP 4 Food serving COLD	6	Temperature and time of food serving control (cold)	**Microbiological:** Multiplication of microorganisms and bacterial spores. **Chemical:** Production of toxins of microorganisms present in food.	6.1.	Temperature and time of food serving monitoring: (maximum of 4 hours at the temperature to 8^0C)	Temperature monitoring through the CMS (temperature deviation shown in red)	Continuously every 2 minutes	Chef
Corrective action:				6.1.	In case of deviation from the required temperature it is necessary to remove the food from the cold table and inform the Chef or the person responsible in the shift. Leftovers after serving may be used only by thermal treatment at the required temperature. Until the thermal treatment, the leftovers must be separately stored in refrigeration devices (separate device or space within the device intended for the type of food).			

Information technology monitoring of refrigeration equipment and food serving is controlled and monitored on the CMS (Figure 2), where an insight into the temperature levels of each refrigerating device and of the cooling table can be obtained at any time. Since the main screen of the programme is the "temperature measurement", all temperature levels at individual measuring points can be seen. They are displayed by diagrams (Figures 3 and 4).

In case the alarm is activated, it needs to be checked whether the device is switched on, whether the device is in the condition of defrosting (DEFROST), whether the door is closed, whether a greater amount of fresh goods has been inserted.

If the alarm is not caused by any of the above, be sure to call the technical service engineer on duty and fill in the Records on identifying inconsistencies.

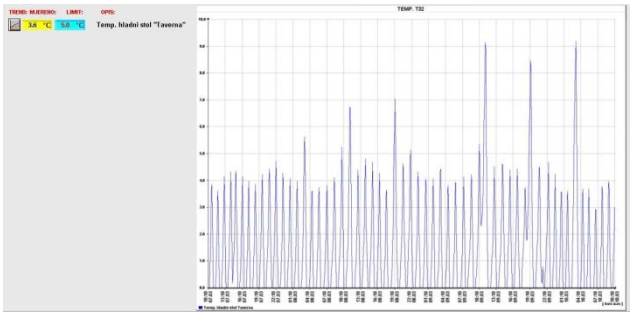

Figure 3. Temperature overview – cold table

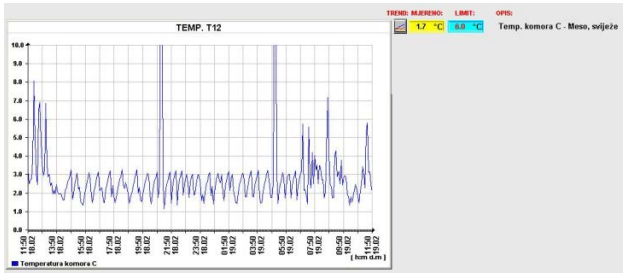

Figure 4. Temperature overview – fresh meet chamber

4.4. Implementation of the CP and CCP monitoring

The HACCP team leader daily views the state of diagrams on all devices. In case of irregularities, he warns technical service.

The HACCP team leader and representative of the Technical Services list and review the diagrams of refrigerating equipment every fifteen days.

On the diagrams listed, they enter the label OK in case of regular status or describe the cause of temperature deviations and undertaken corrections/ corrective actions. Reviewed diagrams are signed by the HACCP team leader and Technical service representative.

5. CONCLUSION

The implementation of the system and application software equipment of the central monitoring system (CMS) in the monitoring of CPs and CCPs represents the optimal solution. The advantage of such a system has been recognized and applied in the hospitality of the hotel Termal in Daruvarske toplice. It is reflected in the continuous monitoring, immediate identifying of deviations from the set parameters, establishing the equipment failures, facilitated documenting of parameters and creating a database that can be used for trend analysis and implementation of preventive actions, which influences the optimization of human resources, which ultimately facilitates continuous quality implementation and maintenance of the HACCP system.

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